DOCUMENT RESUME

ED 220 604 CE 033 409

AUTHOR	Vittetoe, Jerry
TITLE	Data Processing Volume I. Instructor's Guide.
INSTITUTION	Missouri Univ., Columbia. Instructional Materials Lab.
REPORT NO	BOE-15-I
PUB DATE	Jul 82
NOTE	568p.; Not available in paper copy due to colored paper in the original.
AVAILABLE FROM	Instructional Materials Laboratory, 10 Industrial Education Bldg., University of Missouri-Columbia, Columbia, MO 65211 ($25.00).
EDRS PRICE	MF02 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Behavioral Objectives; Computer Programs; Computers; *Computer Science; Course Descriptions; *Data Processing; *Data Processing Occupations; Employment Opportunities; Job Skills; Learning Activities; Lesson Plans; Office Occupations Education; *Programing; Programing Languages; Teaching Guides; Transparencies

ABSTRACT

These instructional materials are intended as a guide for the instructor of a block course in introductory vocational data processing. A textbook and supplementary materials of the instructor's choice would probably be used in conjunction with these materials. Topics covered in the 11 units are background and uses of data processing, input/output devices and media, data entry and manual accounting, central processing unit, introduction to control systems, program planning, basic programming, RPG (Report Program Generator) computer programming, COBOL programming, careers in data processing, and laws, ethics, and issues. Each unit may contain some or all of the following: unit and specific objectives; lesson outline with suggested instructor and student activities, and list of needed instructional materials; information sheets in outline form; handouts; transparency masters; assignment sheets; answers to assignment sheets; job sheets, unit examination; and answers to examination. Appendixes include a resource list and glossary. (YLB)

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ED220604

INSTRUCTOR'S GUIDE

DATA PROCESSING
VOLUME I

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University of Missouri-Columbia
Columbia, Missouri

Catalog Number BOE-15-I
July 1982

CE 033409

ACKNOWLEDGEMENTS

Appreciation is extended to those individuals who contributed their time and talents to the development of this curriculum guide.

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FOREWORD

These instructional materials are intended as a guide for the instructor of a block course in introductory vocational data processing. A textbook and supplementary materials of the instructor's choice would probably be used in conjunction with these materials. Also, availability of equipment, especially for the programming units, is assumed in a vocational setting. Most, if not all, of the contents can be used to integrate data processing concepts and principles into other business courses.

Smaller, simpler, less expensive computers are being utilized by increasing numbers of businesses, industries, schools, and homes. More and more people are being exposed to computers and at an earlier age. With the lives of virtually all people being affected by computers, computer literacy is increasingly helpful, if not absolutely necessary. Computer technology is rapidly changing and people should be willing to keep up with those changes. Beyond this instructional guide, the instructor needs to be willing to keep abreast of developing technology and computer utilization to provide more effective classroom instruction.

Introductory data processing can serve useful purposes for providing computer literacy, exploring careers, training data processing users, and motivating future data processing professionals.

DATA PROCESSING

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BACKGROUND AND USES OF DATA PROCESSING
UNIT I

UNIT OBJECTIVE

After studying this unit, students should be able to define data processing, explain the historical and current contribution of computers to data processing, detail generalities about computer systems, and describe uses of computers.

SPECIFIC OBJECTIVES

After completing this unit, students should be able to:

1. Define data processing and related terms.
2. Identify the five functions of processing data.
3. Match three people in computer development with their inventions.
4. List the four characteristics of a computer.
5. Select the appropriate computer generation based on characteristics of each generation.
6. Distinguish between analog and digital computers.
7. List characteristics of each of the six sizes of computer systems.
8. Distinguish among computer hardware, software, and firmware.
9. List two reasons for computer user dissatisfaction.
10. Describe the various applications of computers and data processing.

BACKGROUND AND USES OF DATA PROCESSING
UNIT I

SUGGESTED ACTIVITIES

I. Instructor

   A. Make transparencies.

   B. Provide students with objectives and discuss.

   C. Provide students with information and assignment sheets and discuss.

   D. Give examination.

II. Student

   A. Read objectives.

   B. Study information sheets as presented and assigned by instructor.

   C. Complete assignment sheets and supplementary assignments.

   D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit content

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM-I-1: What is Data Processing?

      2. TM-I-2: Business Data Processing

      3. TM-I-3: Four Ways of Processing Information

      4. TM-I-4: Components of a Manual Data Processing System

      5. TM-I-5: Data Processing Functions

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6. TM-I-6: Data Processing Operations
7. TM-I-7: Hierarchy of Data
8. TM-I-8: Facts, Records, and Files
9. TM-I-9: Computer "Generations"
10. TM-I-10: Computer Speeds
11. TM-I-11: Computer Generations Compared
12. TM-I-12: Types of Computers
13. TM-I-13: Digital and Analog Devices
14. TM-I-14: Components of a Computer System
15. TM-I-15: "Computer-on-a-Chip"
16. TM-I-16: Basic Terms
17. TM-I-17: Computers Have Many Uses[1]
18. TM-I-18: Computers Have Many Uses[2]
19. TM-I-19: Computers Have Many Uses[3]

D. Assignment sheets
   1. AS-I-1: Data Processing Awareness
   2. AS-I-2: Data Processing Operations
   3. AS-I-3: Data Processing Cycle
   4. AS-I-4: Digital/Analog
   5. AS-I-5: Fun and Games With the Computer

E. Answers to assignment sheets

F. Examination

G. Answers to examination

BACKGROUND AND USES OF DATA PROCESSING
UNIT I

INFORMATION SHEET

I. Terms and Definitions

A. Analog computer - calculating machine that uses measurements to represent quantities that can be measured. Analog computers are not studied in this chapter.

B. Byte - unit of computer memory which can represent any digit, letter of alphabet, or special character Smallest unit of memory that can have an address

C. Computer - information-handling device in which data and instructions for processing data are represented by electronic codes or impulses

D. Central Processing Unit (CPU) - that part of computer that receives and stores instructions and data, performs arithmetic and logic operations, and directs action of input and output units

E. Computer Assisted Instruction (CAI) - process by which students use computers directly for learning new subjects

F. Data processing - converting information into usable form

G. Digital computer - computer that works with numbers or letters of alphabet and special characters that can be coded numerically. Solves problems electronically by counting, adding, subtracting, multiplying, and dividing. All references in this chapter refer to digital.

H. Firmware - system programs which are stored in Read-Only Memory

I. Hardware - term used to describe any physical equipment or components in an electronic computer system

J. Input - data that enter system for processing

K. Internal storage (memory) - memory of CPU

L. K (kilobyte) - usually considered as 1,000 bytes or exactly 1,024 bytes

M. Languages - different ways of communicating with the computer

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N. Machine language - any language that can be understood and carried out by the computer

O. Mainframe - larger computers; the heart of the computer system to which all other devices are connected

P. Microseconds - a millionth of a second

Q. Milliseconds - one-thousandth of a second

R. Minicomputer - small, inexpensive computer that has CPU and one or more input/output devices; often low enough in price that it can be purchased rather than rented

S. Output - processed information

T. Peripheral devices - various units or machines that are used in combination or conjunction with the computer but are not part of the computer itself, such as typewriter, sorters, tape readers

U. Software - term used to describe programs (instructions) that cause hardware to function

V. Terminal - input/output device consisting of typewriter keyboard and printer or display; enables user to have contact with computer

W. Word processing - the production of readable information using efficient management of people, procedures, and equipment

II. Ways and Functions of Processing Data

A. Ways of processing data (Refer to TM-I-1, TM-I-2, TM-I-3, TM-I-4, and AS-I-1.)

1. Manual
2. Mechanical
3. Automated (electronmechanical)
4. Electronic

B. Data processing functions (Refer to TM-I-5, TM-I-6, AS-I-2, and AS-I-3.)

1. Input
2. Processing
    a. Classifying
    b. Sorting

c. Calculating

d. Summarizing

3. Output

4. Storage

5. Control

C. Data hierarchy (Refer to TM-I-7 and TM-I-8.)

1. Characters - letters, digits, and symbols

2. Data items (or field) - collections of related characters

3. Records - collections of data items

4. Files - collections of related records

D. Computer cost-effectiveness

1. Rapid response required

2. Fast processing speeds necessary

3. Large quantities of data to be processed

III. Evolution of the Computer - Data processing has always been necessary for tax information, business transactions, census data, etc. Earlier methods of processing were slow and storage was cumbersome; hence, the computer evolved. Development of the computer can be attributed to the following individuals.

A. Joseph Jacquard - 1801

1. Weaving device - loom

2. Used punched cards

3. Loom could produce intricate patterns and designs

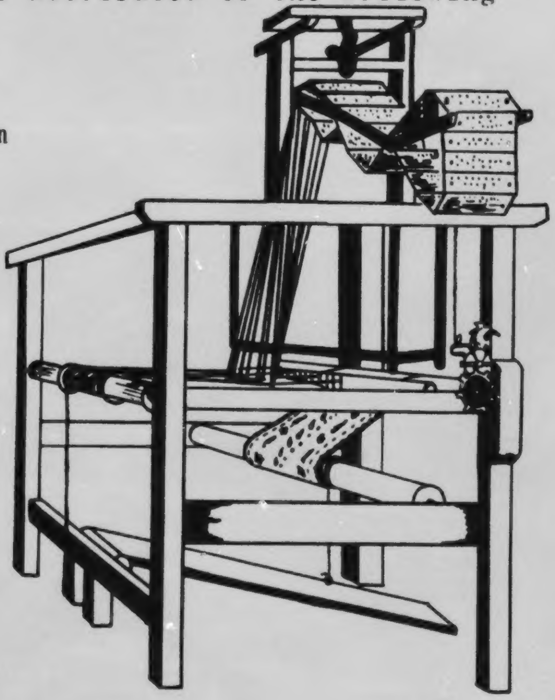

Figure 1: The Jacquard Loom

B. Charles Babbage - 1833

1. Analytical engine
2. Punched cards for operations control and data input
3. Performed arithmetic functions, storage, and output
4. Steam powered idea was 100 years too early.

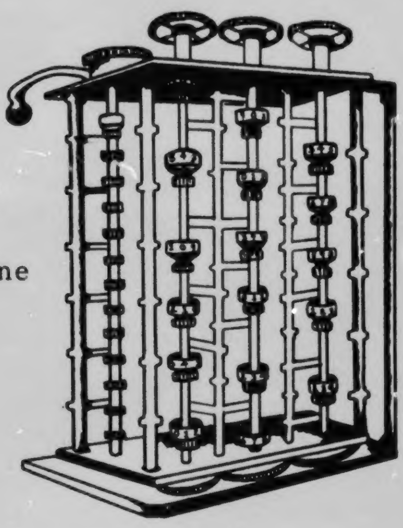

Figure 2: Babbage's Analytical Engine

C. Dr. Herman Hollerith - 1887

1. Machine-punched holes in cards
2. Machine-tabulated census cards
3. Formed company now known as IBM

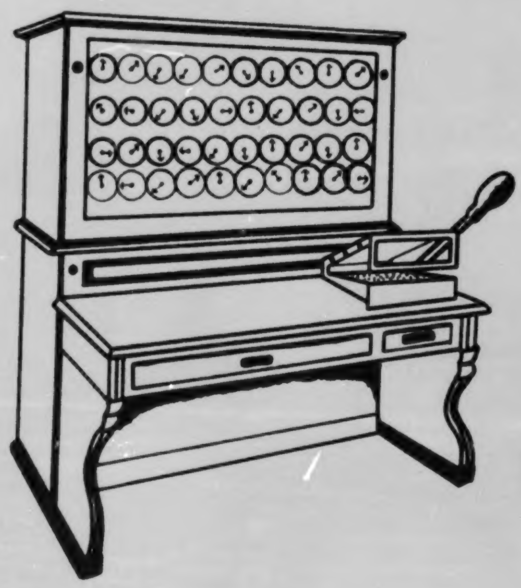

Figure 3: Hollerith's Tabulating Machine

IV. Computer Development and Characteristics

A. A computer system consists of devices which can calculate and compute, other devices which enable data to enter the system (input), and devices which cause data to be presented in a desired form for use by people (output). (Refer to TM-I-9.)

B. Characteristics of a computer

1. Electronic elements
2. Internal storage (memory)
3. Stored programs
4. Program modifications

V. Computer Generations (Refer to TM-I-9, TM-I-10, and TM-I-11.)

A. First generation

1. Vacuum tubes
2. Large size
3. High heat generation
4. High repair and maintenance requirements
5. Programmed in machine language

B. Second generation

1. Transistors and magnetic cores
2. Faster and smaller than first generation
3. Symbolic languages developed
4. Utilized magnetic tape and disk storage

C. Third generation

1. Miniaturization and modularity
2. Integrated circuits with increased storage capacity
3. Increased speed and decreased size
4. Improved input/output with more devices
5. High level languages developed
6. Remote terminals

D. Fourth generation

    1. Microminiaturization

    2. Further size reduction and faster speeds

    3. More reliability

    4. Less human intervention required

    5. Mini and micro computers

    6. Improved peripheral devices

E. Computer generations compared (Refer to TM-I-11.)

VI. Types of Computers (Refer to TM-I-12, TM-I-13, and AS-I-4.)

A. Analog - physical sciences

    1. Measures continuous quantities with gauges, meters, and wheels

    2. Slide rule, gasoline pump, thermometer, auto speedometer

B. Digital - business applications

    1. Counts discrete quantities

    2. Adds, subtracts, multiplies, and divides

C. Hybrid - combination of analog and digital

VII. Characteristics of Computer Systems (Refer to TM-I-14 and TM-I-15.)

A. General characteristics of business computers

    1. Large computer systems - may have more than one CPU (Central Processing Unit). Definition: CPU - Central Processing Unit, Mainframe--the heart of the computer system to which all other devices are connected. The CPU handles control, logic, and arithmetic functions.

    2. Many input/output devices

    3. Most expensive - usually leased

    4. Most powerful

    5. Fast storage with large capacity

B. Six sizes of computer systems and their characteristics (K refers to capacity of internal storage; K = 1,000 bytes)

1. Super
    a. $5 to $12 million cost
    b. 5,000K and above
2. Large
    a. $1 to $5 million cost
    b. 2,000K to 5,000K capacity
3. Medium
    a. $200,000 to $1 million cost
    b. 256K to 2,000K capacity
4. Small
    a. $50,000 to $200,000 cost
    b. 32K to 256K capacity
5. Mini (small business computers)
    a. Smaller computer system - one CPU - 4K to 128K capacity
    b. Fewer input/output devices
    c. Cost - $15,000 to $50,000 - often purchased
    d. May be connected to a larger system
    e. Used for applications for which larger computers are impractical
6. Micro (personal computers)
    a. Computer on a chip
    b. Many uses - home, school, business
    c. Least expensive system - under $15,000 - as little as $200
    d. Small capacity - 1K to 64K

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VIII. Computer Hardware, Software, and Firmware (Refer to TM-I-16.)

A. Computer hardware - physical machinery and equipment

1. Input/output devices

2. CPU

3. Secondary storage units

4. Data preparation equipment

B. Computer software - programmed instructions which cause the computer to perform and solve problems

1. Applications programs

2. Operation systems programs

C. Firmware - instructions stored or built into the computer which cannot be altered by the user; an example is Read Only Memory (ROM)

IX. Reasons for Computer User Dissatisfaction

A. People failed to correctly analyze and design the computer installation.

1. Improper implementation

2. Inadequate user education

B. Poor communications

1. Business language

2. Computer jargon

C. Equipment incompatibility

1. Differences in equipment generations

2. Differences in vender equipment

3. Improper selection of equipment

X. General Computer Uses (Refer to AS-I-5.)

A. Accounting

1. Payroll

2. Receivables and payables

        3. Ordering
        4. Inventory
        5. Operations analysis
        6. General recordkeeping
    B. Word processing
        1. Letters
        2. Reports
        3. Manuscripts
        4. Electronic mail

XI. Specific Computer Uses (Refer to TM-I-17, TM-I-18, and TM-I-19.)

    A. Retailing
        1. Recording transactions
        2. Verification of payment method
        3. Inventory control
    B. Banking and finance
        1. Automatic tellers
        2. Savings and checking account records
        3. Stock market transactions
        4. Electronic funds transfer
        5. Direct deposit
    C. Travel
        1. Passenger reservations
        2. Scheduling freight
        3. Control of traffic - land, sea, and air
        4. Automobile performance
    D. Government
        1. Selecting tax returns to audit

    2. Control space vehicles
    3. Census
    4. Weather forecasting
    5. Voting and voter registration
    6. Military maneuvers
    7. Law enforcement

E. Home
    1. Budgets and financial records
    2. Video games
    3. Energy control
    4. Security control

F. Schools
    1. Registration
    2. Schedule classes
    3. Student records
    4. Library check-out systems
    5. Computer-Assisted-Instruction (CAI)

G. Hospitals and medicine
    1. Diagnose
    2. Patient monitoring
    3. Patient records

H. Manufacturing
    1. Production processes
    2. Machinery control

I. Design engineering

J. Sporting events
    1. Scoreboard control
    2. Statistics

24

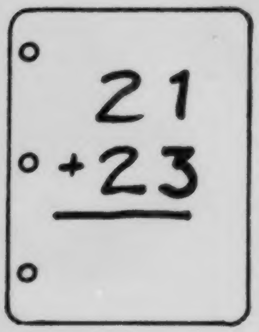
K. Electronic media

  1. Books
  2. Newspapers
  3. Magazines
  4. Information sources

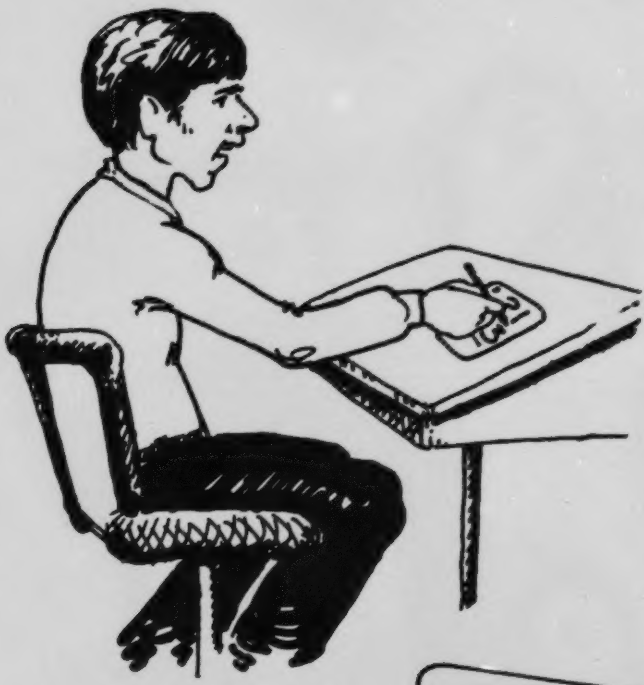
TM-I-1

What is Data Processing?

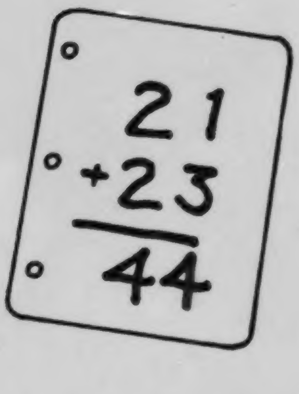
Data (information)



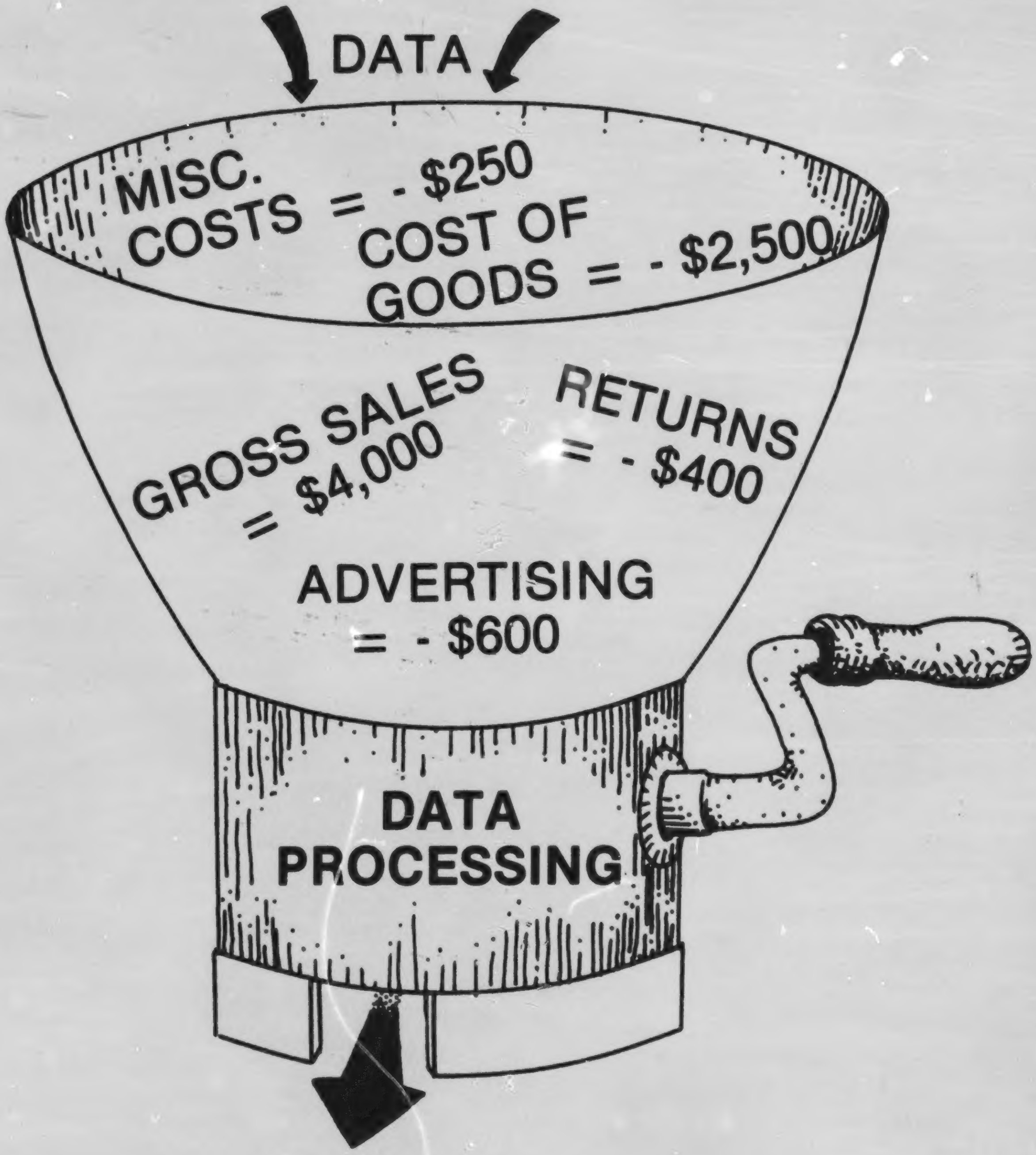
Processing



Desired or Usable Result



Business Data Processing


DATA
MISC. COSTS = - $250
COST OF GOODS = - $2,500
GROSS SALES = $4,000
RETURNS = - $400
ADVERTISING = - $600
DATA PROCESSING

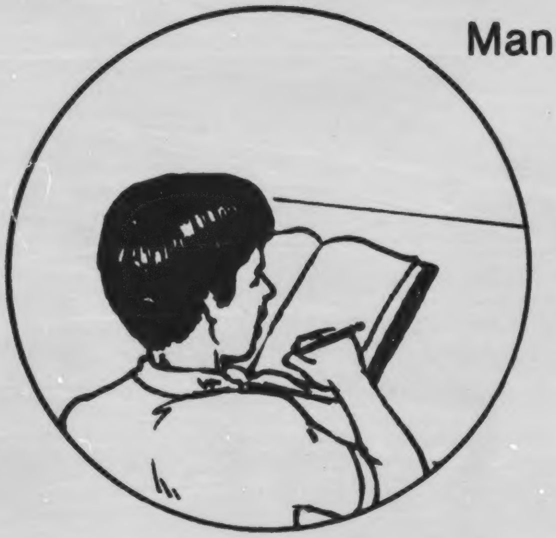
INFORMATION

NET PROFIT = $250

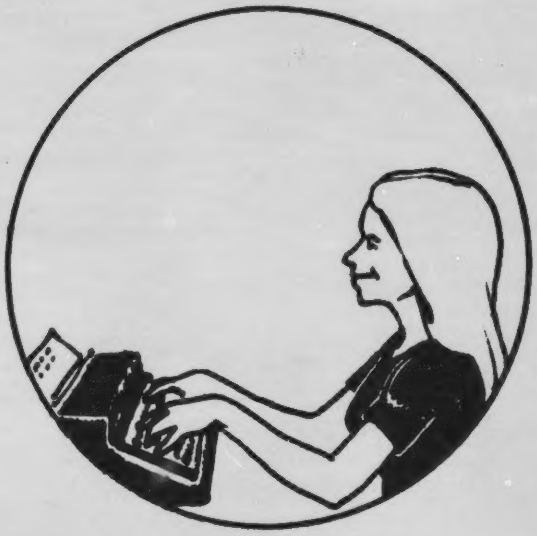
TM-I-3

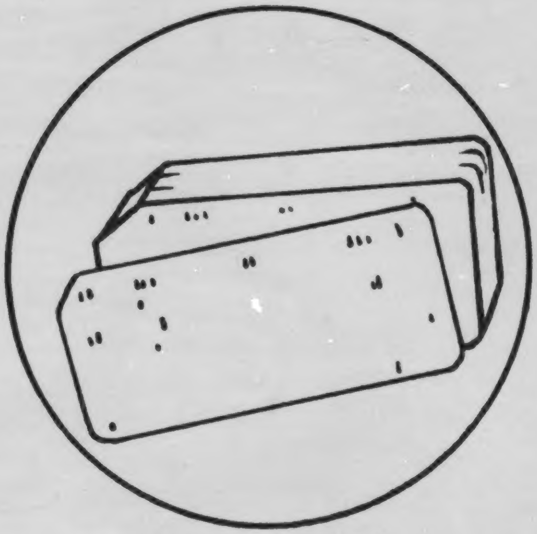
Four Ways of Processing Information

Manual

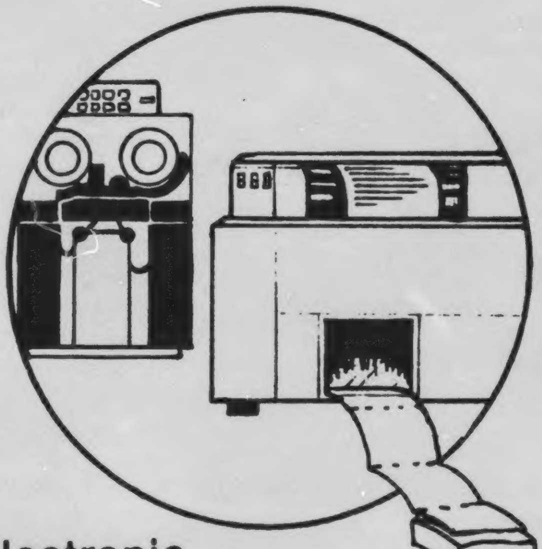


Mechanical



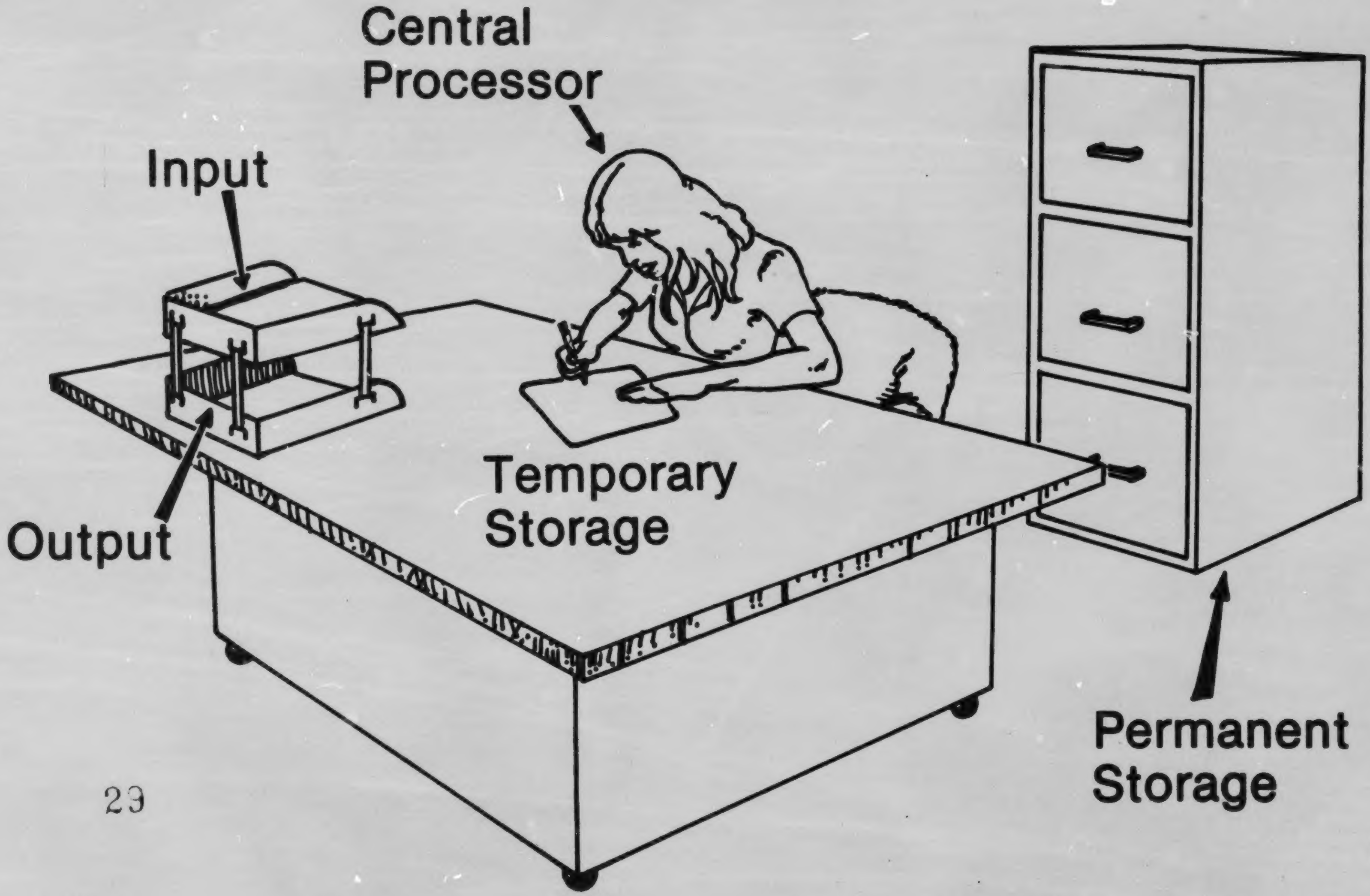


Automated



Electronic

Components of a Manual Data Processing System


Central Processor
Input
Temporary Storage
Output
Permanent Storage

Data Processing Functions

Input

Such as:

1. Pay rate
   Hours worked
3. Payroll deductions

→

Processing

a. Classifying
b. Sorting
c. Summarizing
d. Reproducing
e. Calculating
f. Storing

→

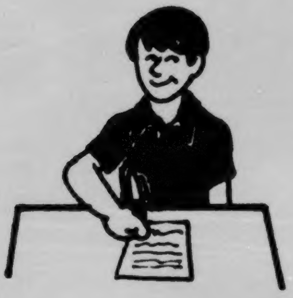
Output

Such as:

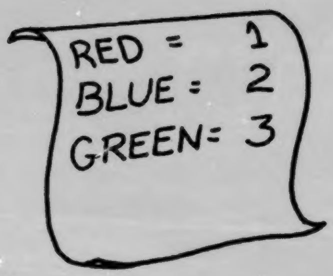
1. Paychecks to employees
2. Payroll reports to managers

Data Processing Operations

(Control Present in each Operation)

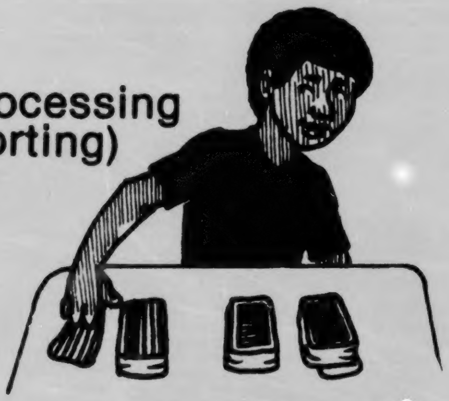


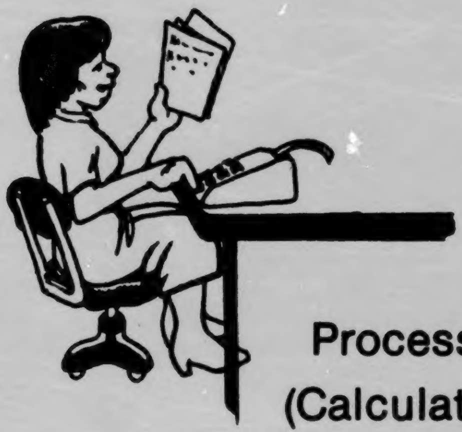
Input (Recording)


RED = 1
BLUE = 2
GREEN = 3

Processing (Classifying)

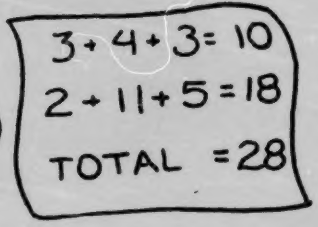
Processing (Sorting)

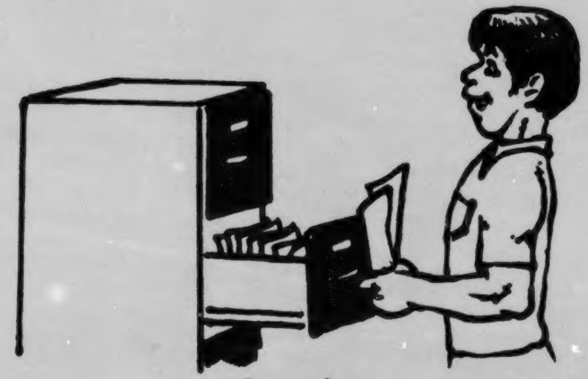




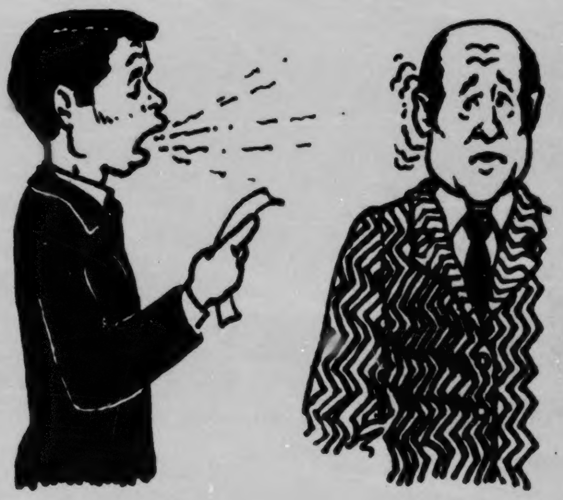
Processing (Calculating)

Processing (Summarizing)


3 + 4 + 3 = 10
2 + 11 + 5 = 18
TOTAL = 28



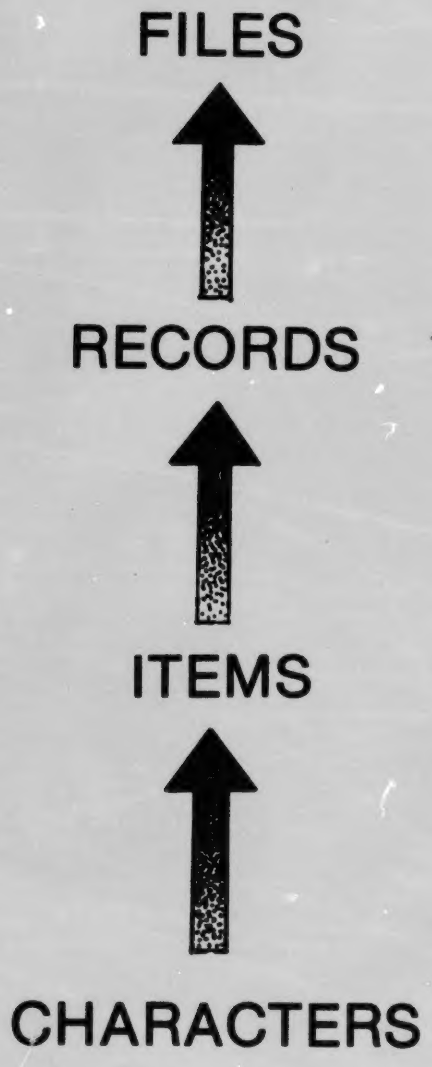
Storing



Output (Communicating)

TM-I-7

Hierarchy Of Data



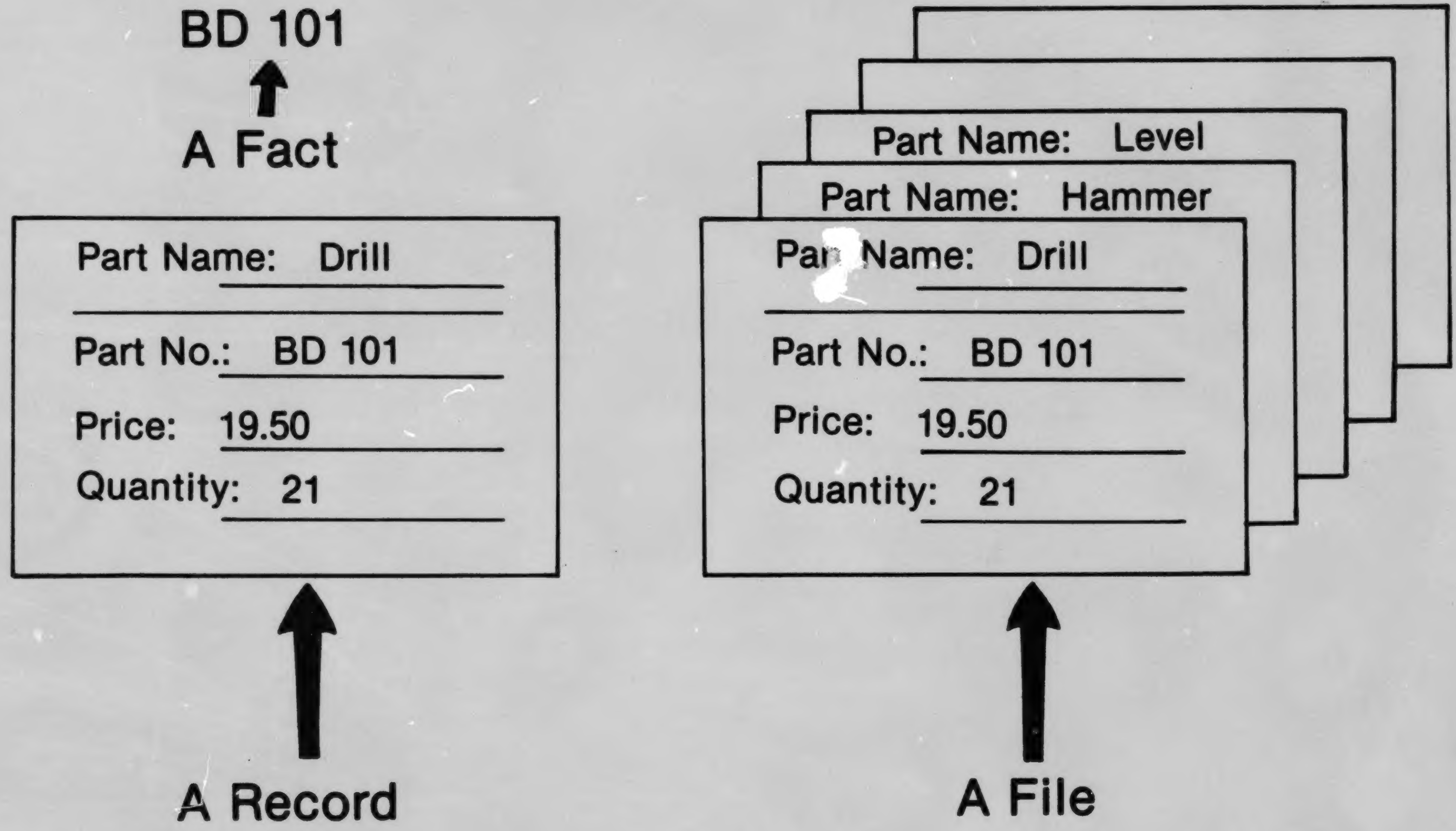
FILES

RECORDS

ITEMS

CHARACTERS

Facts, Records, And Files



BD 101

A Fact

Part Name: Drill

Part No.: BD 101

Price: 19.50

Quantity: 21

A Record

Part Name: Level

Part Name: Hammer

Part Name: Drill

Part No.: BD 101

Price: 19.50

Quantity: 21

A File

Computer "Generations"

First

vacuum tubes
large
generated heat
high maintenance and repair

Second

smaller and faster
transistors
symbolic programming
utilizes magnetic storage

Third

miniaturization
faster - 1 million calculations/second
large storage capacity
improved input/output
remote terminals
higher level languages

Fourth

microminiaturization
even faster and smaller
minicomputers and microcomputers
less human intervention

Computer Speeds

MILLISECOND

$\frac{1}{1,000}$ SECOND

MICROSECOND

$\frac{1}{1,000,000}$ SECOND

NANOSECOND

$\frac{1}{1,000,000,000}$ SECOND

PICOSECOND

$\frac{1}{1,000,000,000,000}$ SECOND

Computer Generations Compared

	First	Second	Third	Fourth
Cost for operation	$14.54	$2.48	59 cents	28 cents
Speed	Milliseconds	Microseconds	Nanoseconds	Picoseconds
Processing time	375 seconds	47 seconds	37 seconds	5 seconds
Technology	Vacuum tubes	Transistors	Solid-state logic	Integrated circuits

Types of Computers

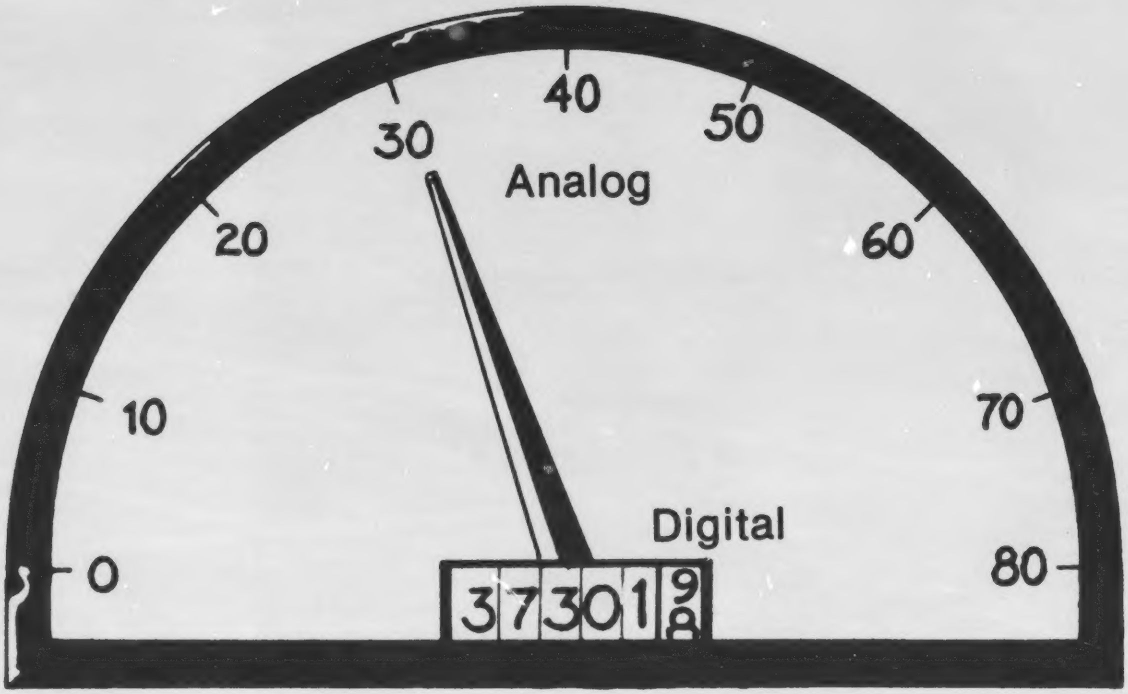
ANALOG → MEASURE

DIGITAL → COUNT

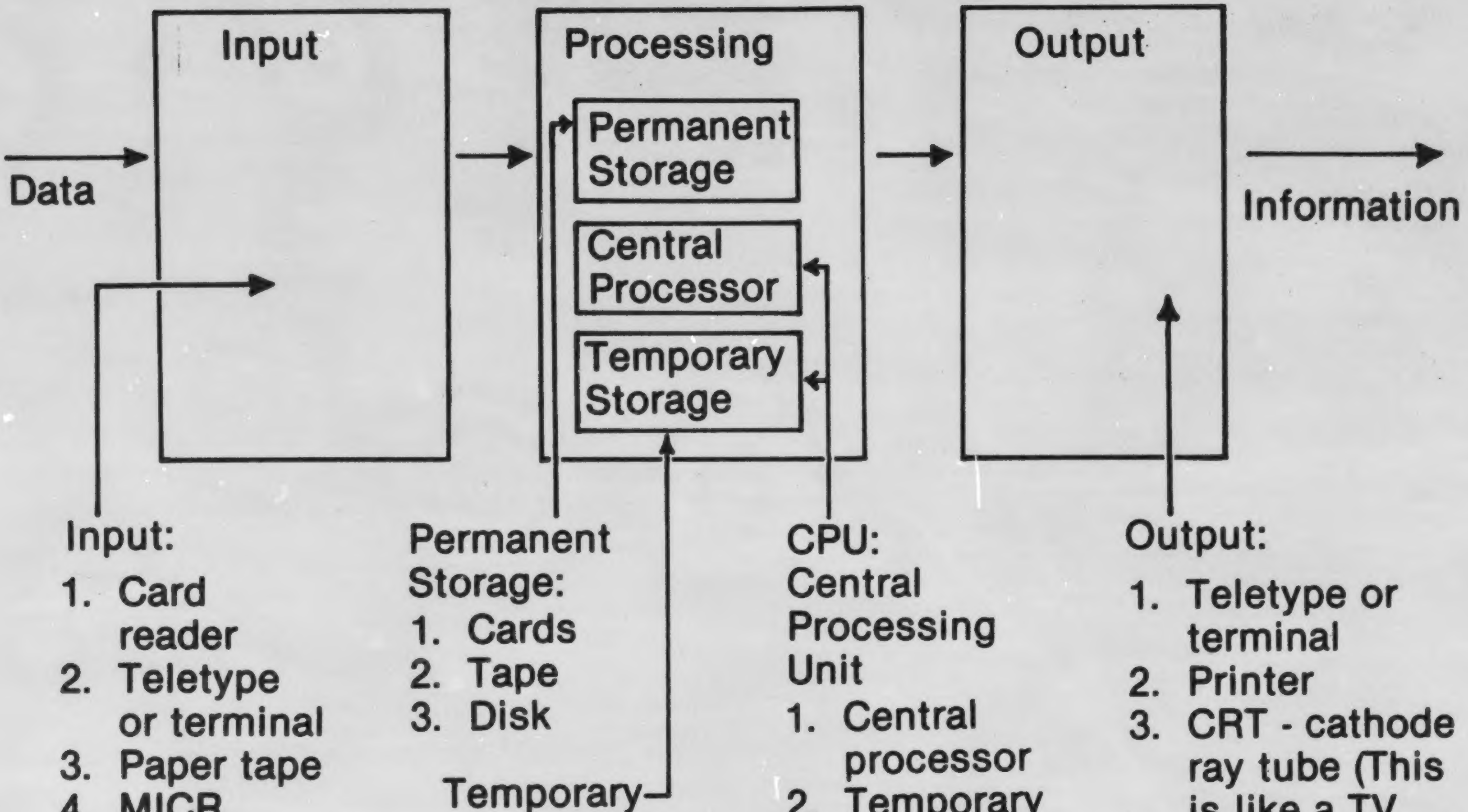
HYBRID → ANALOG + DIGITAL

41

Digital and Analog Devices


0
10
20
30
40
50
60
70
80
Analog
Digital
373019

Components of a Computer System



Data

Input

Processing

Permanent Storage

Central Processor

Temporary Storage

Output

Information

Input:
1. Card reader
2. Teletype or terminal
3. Paper tape
4. MICR reader
5. Optical scanner

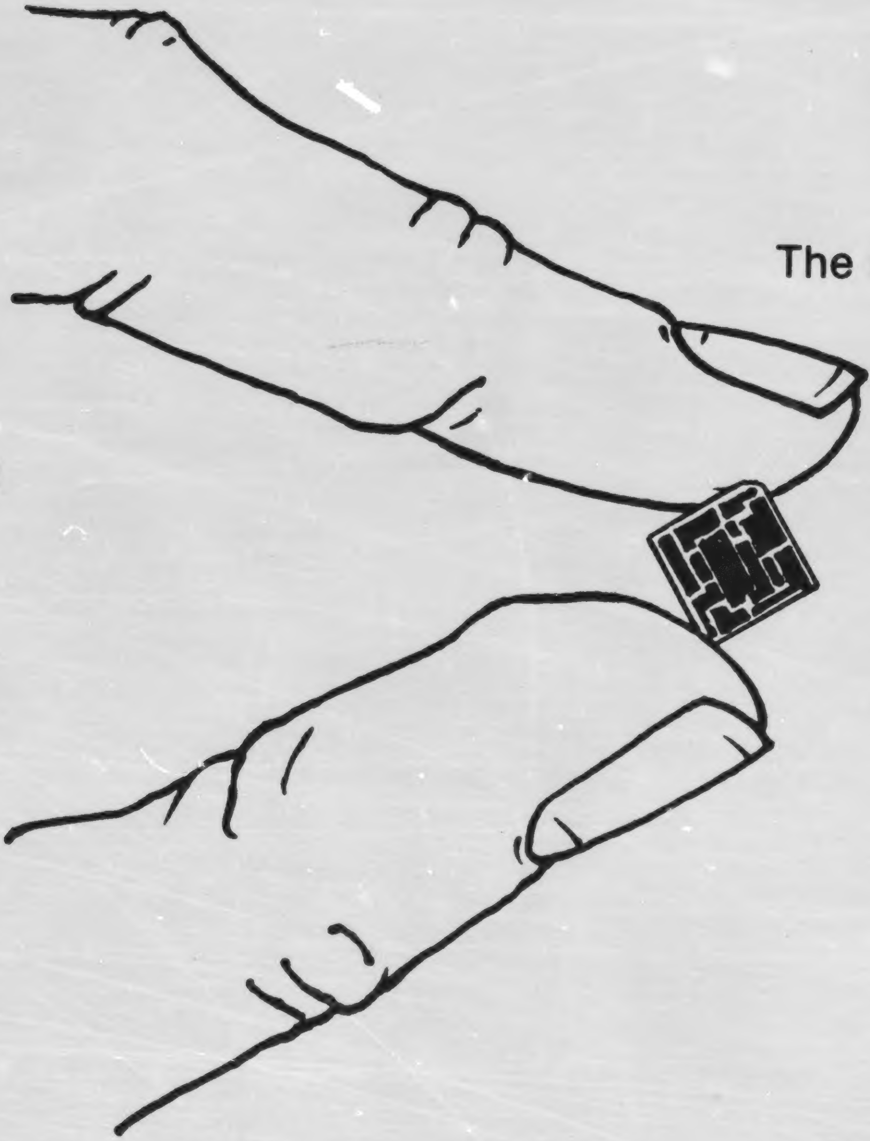
Permanent Storage:
1. Cards
2. Tape
3. Disk

Temporary Storage:
This device has been called:
1. Main storage, or
2. Memory, or
3. Core storage

CPU:
Central Processing Unit
1. Central processor
2. Temporary storage

Output:
1. Teletype or terminal
2. Printer
3. CRT - cathode ray tube (This is like a TV screen.)
4. Paper tape punch

"Computer-on-a-Chip"



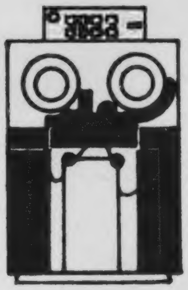
The silicon "chip"

(1/16 inch square - integrated circuit package)

Basic Terms

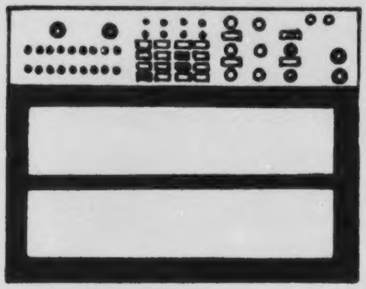
Hardware - Physical parts of a data processing system

Input



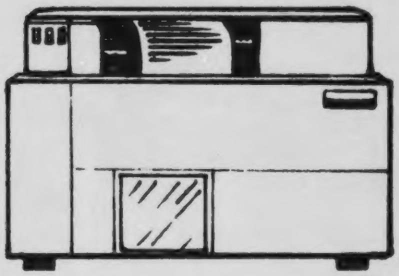
(tape drive)

Processing



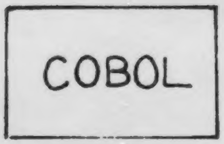
(CPU)

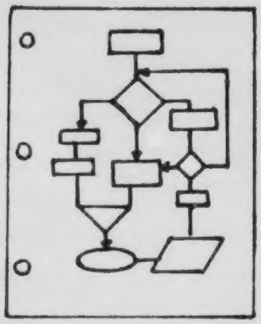
Output

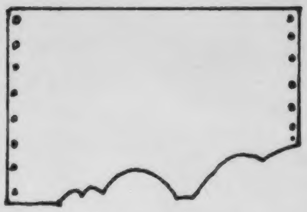


(Printer)

Software - Programs, procedures, documentation





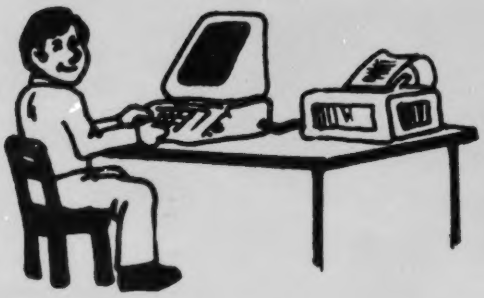


Firmware - Instructions stored or built into the computer

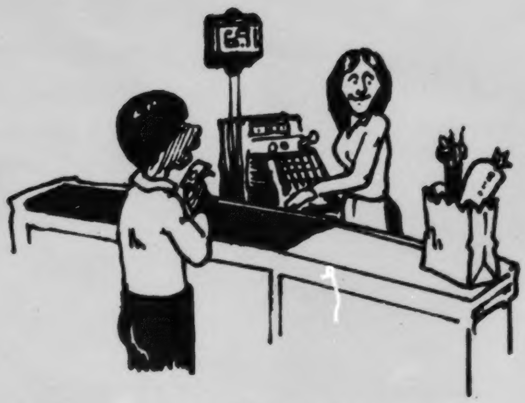
Acronym - Word made from letters of words in a phrase or name
CPU (Central Processing Unit)
EDP (Electronic Data Processing)
CRT (Cathode Ray Tube)

TM-I-17

Computers Have Many Uses[1]

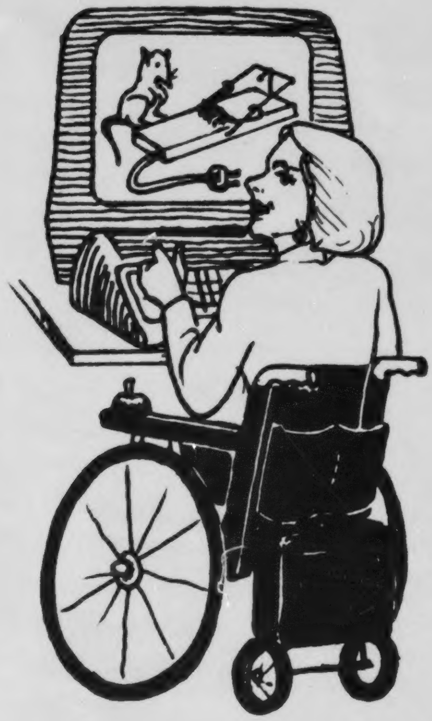


Word Processing

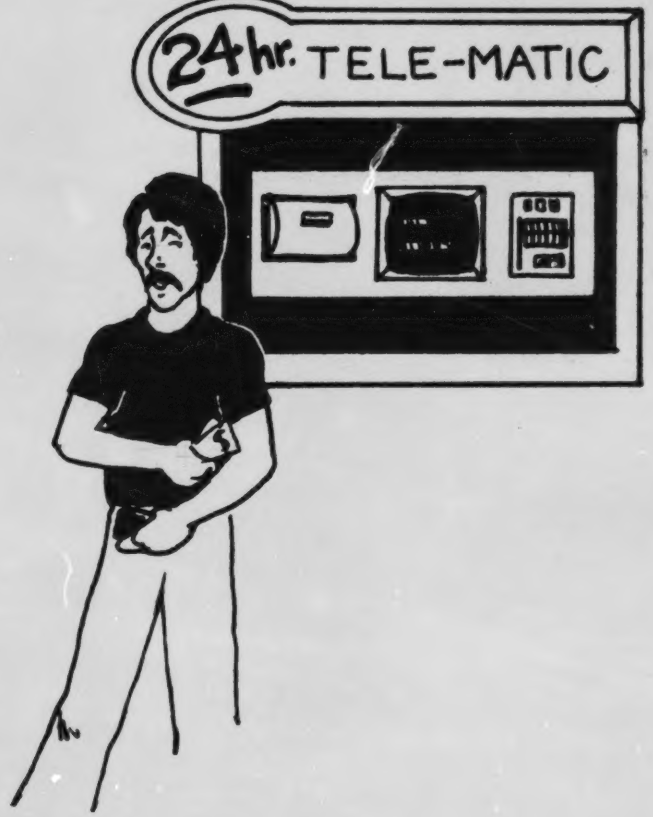


Grocery Checkout

Graphic Display - Design

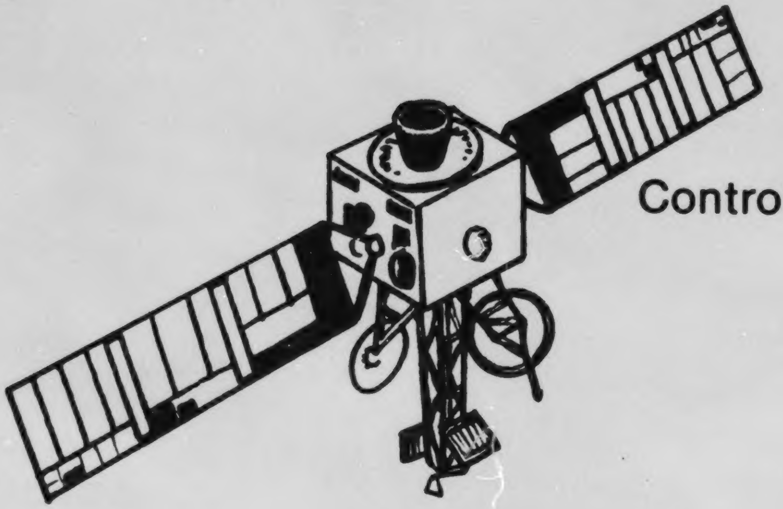


24-Hour Banking


24hr. TELE-MATIC

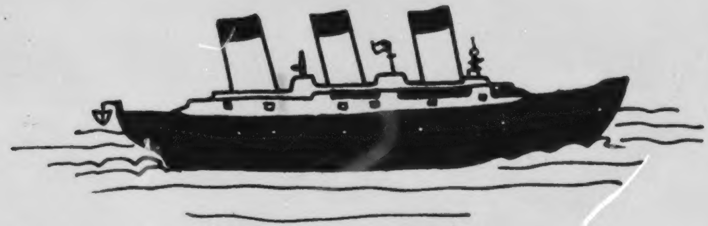
TM-I-18

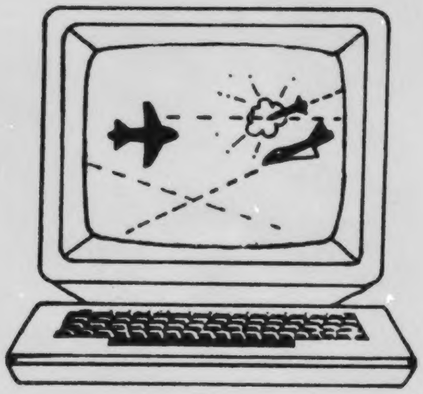
Computers Have Many Uses[2]



Control Space Satellites

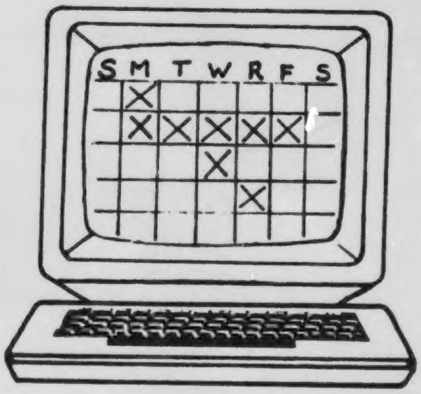
Navigate Ships

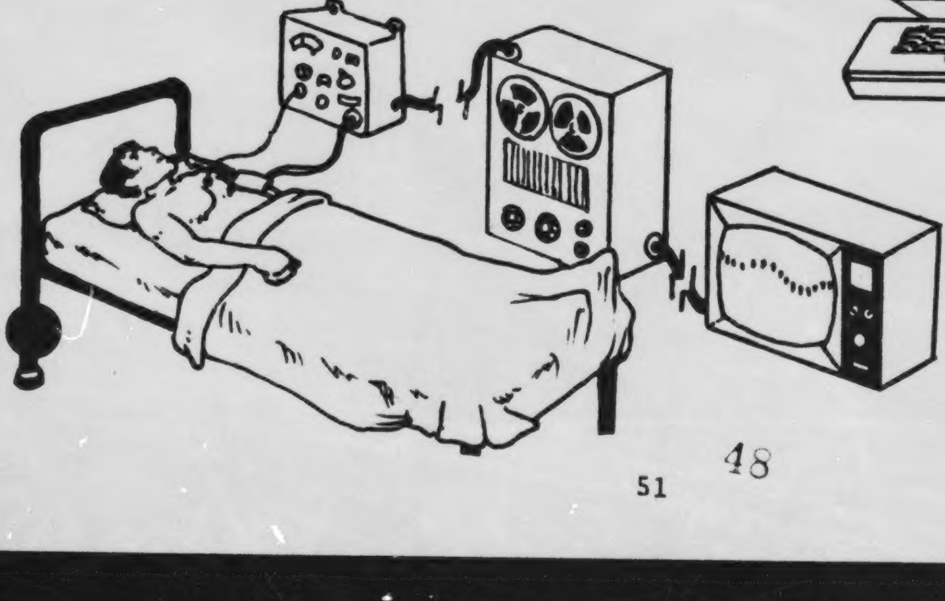




Play Games

Schedule Classes

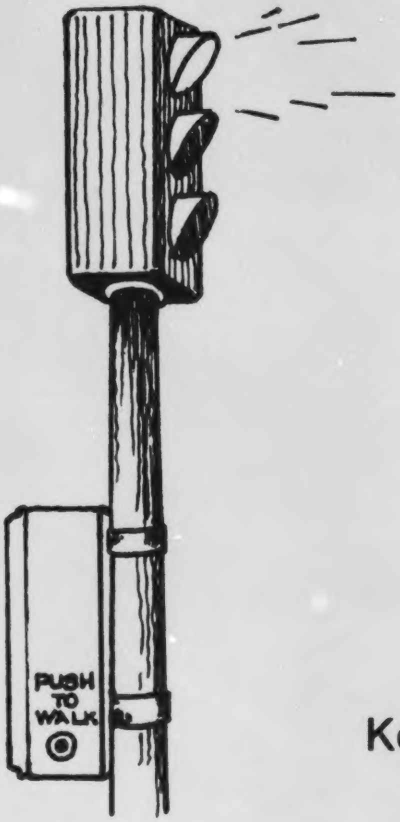


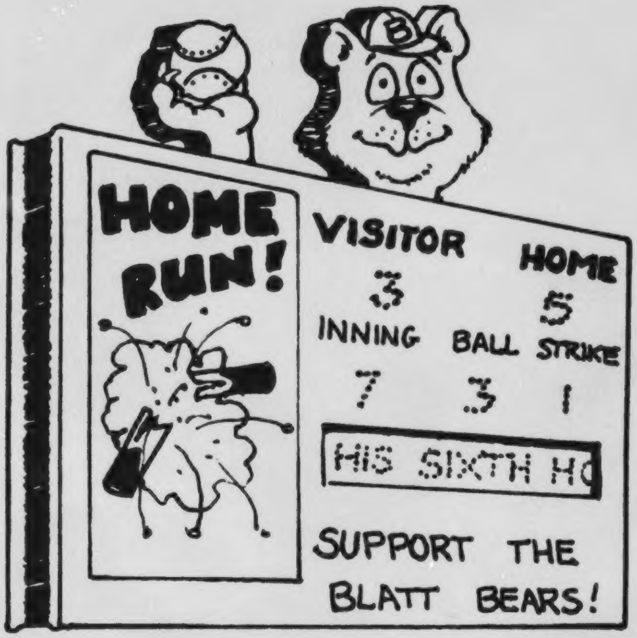


Monitor Patients

Computers Have Many Uses[3]

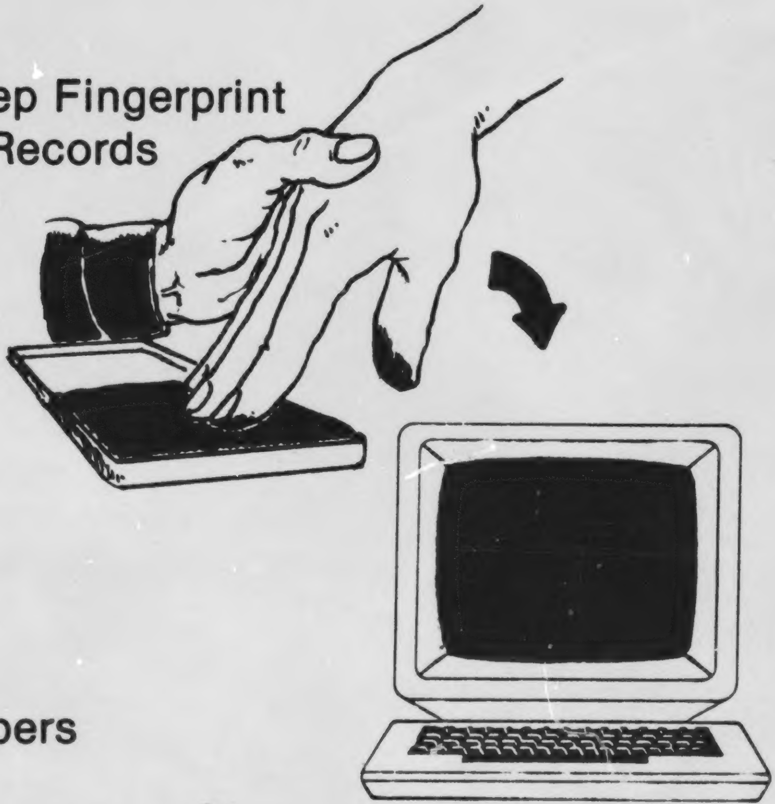
Control Stoplights

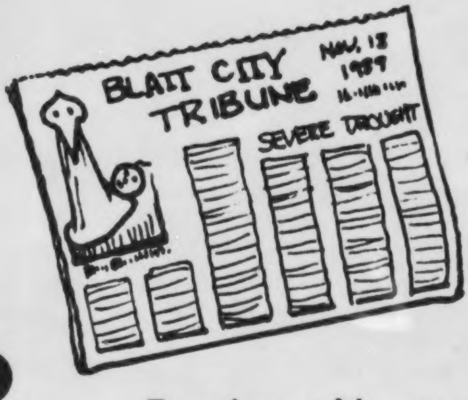

PUSH
TO
WALK


HOME RUN!
VISITOR
HOME
3
5
INNING
BALL
STRIKE
7
3
1
HIS SIXTH H
SUPPORT THE BLATT BEARS!

Operate Athletic Scoreboards

Keep Fingerprint Records




BLATT CITY TRIBUNE
NOV. 13 1989
SEVERE DROUGHT

Produce Newspapers

ASSIGNMENT SHEET #1: DATA PROCESSING AWARENESS

Directions: Have you observed some ways data are processed in your school and home? List two ways you see data being processed and explain how recording, classifying, sorting, calculating, summarizing, communicating, and storing operations are involved in each process. If you do not see how one of these operations is involved in the process you are analyzing, place NA in the space beside that operation. Be prepared to discuss your answer in class.

1. Process:

   Recording

   Classifying

   Sorting

   Calculating

   Summarizing

   Communicating

   Storing

2. Process:

   Recording

   Classifying

   Sorting

   Calculating

   Summarizing

   Communicating

   Storing

50

ASSIGNMENT SHEET #2: DATA PROCESSING OPERATIONS

Directions: Complete the following steps.

Step 1: On 3 x 5 index cards or paper cut this size, copy the following information. Each line represents one card. Look at the example below. If items 2 or 3 are blank, leave the space blank on your card. (RECORDING AND CLASSIFYING)

EXAMPLE:

Adams, John D 100 A 50 B 20

Data:

Name	Item^1	Price	Item^2	Price	Item^3	Price
Adams, John	D	100	A	50	B	20
Beech, Thomas	D	100	D	100	D	100
Wagoner, Michael	C	150	D	100	E	200
Morris, Tom	E	200	D	100		
Davis, Sam	C	150	A	50	A	50
Logan, Betty	D	100	E	200	D	100
Berry, Joyce	F	400	A	50		
Fagan, Pat	E	200	A	50	D	100
Jones, Alvin	D	100	D	100	D	100
Severs, Robin	G	175	A	50		

Step 2: Sort the cards into alphabetical order. (SORTING)

Step 3: Determine the total amount of sales for each sale. (CALCULATING)

Step 4: Determine the total amount of sales for each item. (SUMMARIZING)

Step 5: a. Prepare a sales report in alphabetical order using today's date. Type or print the report neatly.

EXAMPLE: Monthly Sales Report

Salesperson	Total Amount
Adams, John	$170
Beech, Thomas	300
Total	$xxxxxxxx

Total Amount Per Item: A_____ B_____ C_____ D_____ E_____
F_____ G_____

b. Submit the monthly sales report and your card deck to your teacher for checking. (COMMUNICATING)

Step 6: When your teacher returns the work, place it with your other materials for this class. (STORING)

BACKGROUND AND USES OF DATA PROCESSING
UNIT I

ASSIGNMENT SHEET #3: DATA PROCESSING CYCLE

PART A
Directions: Several pieces of equipment are listed below. What input and output would you expect from each of these?

Equipment	Input	Output
camera		
vending machine (soft drink)		
food processor		
typewriter		
10-key adding machine		
electric pencil sharpener		

PART B
Directions: List three other pieces of equipment and the input/output for each.

Equipment	Input	Output
1.		
2.		
3.		

BACKGROUND AND USES OF DATA PROCESSING
UNIT I

ASSIGNMENT SHEET #4: DIGITAL/ANALOG

Directions: (a) Explain the difference between digital and analog devices: ____________________

____

____

____

(b) Can you think of several examples of digital and analog devices? List them below. Be able to explain why you have classified each device as digital or analog.

Digital: ____________________

____

____

____

____

____

Analog: ____________________

____

____

____

____

____

BACKGROUND AND USES OF DATA PROCESSING
UNIT I

ASSIGNMENT SHEET #5: FUN AND GAMES WITH THE COMPUTER (An assignment for schools which have access to a computer)

Directions: Select one of the following activities:

1. Following instructions from your teacher, set up a computer game and play the game. APPLE Systems Disc has several video games and Lemonade.

2. Following instructions from your teacher, set up a computer-assisted learning activity. For example, IBM MUSIC system LEARN. Following the computer-given instructions, complete the learning activity.

BACKGROUND AND USES OF DATA PROCESSING
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET #1

Evaluation to be determined by instructor.

ASSIGNMENT SHEET #2

MONTHLY SALES REPORT

Salesperson	Total Amount
Adams, John	$ 170
Beech, Thomas	300
Berry, Joyce	450
Davis, Sam	250
Fagan, Pat	350
Jones, Alvin	300
Logan, Betty	400
Morris, Tom	300
Severs, Robin	225
Wagoner, Michael	450
Total Sales	$3,195

Total Amount Per Item: A $300 B $20 C $300 D $1,100
E $800 F $400 G $175

ASSIGNMENT SHEET #3

Evaluation to be determined by instructor.

ASSIGNMENT SHEET #4

Evaluation to be determined by instructor.

ASSIGNMENT SHEET #5

Evaluation to be determined by instructor.

BACKGROUND AND USES OF DATA PROCESSING
UNIT I

EXAMINATION

1. Define in your own words the following terms.

   a. Data processing

   b. Input

   c. Microseconds

   d. Software

   e. Byte

   f. Hardware

   g. Milliseconds

   h. Central Processing Unit (CPU)

   i. K (kilobyte)

   j. Computer Assisted Instruction (CAI)

   k. Word processing

   l. Output

m. Terminal

n. Language

2. Match the five basic data processing functions with their definition.

____a. Inputting 1. Manipulating the data

____b. Processing 2. Directing computer operations

____c. Outputting 3. Producing useful information

____d. Storing 4. Entering data

____e. Controlling 5. Filing information for future use

_____3. Select the correct sequence from smallest to largest of the elements of data storage hierarchy.

a. Data items, characters, files, records
b. Records, characters, files, data items
c. Characters, data items, records, files
d. Characters, data items, files, records

4. Name two of the three components which determine computer cost-effectiveness.

a.

b.

5. Match each person with their achievement which contributed to the development of the computer.

____a. Babbage 1. Weaving loom

____b. Hollerith 2. Analytical engine

____c. Jacquard 3. Census machinery

6. List three of the four characteristics of a computer.

a.

b.

c.

7. Circle the correct computer generation for the two characteristics listed.

   a. Vacuum tubes and large physical size 1st 2nd 3rd 4th

   b. Integrated circuits and variety of input/output devices 1st 2nd 3rd 4th

   c. Less human intervention and microminiaturization 1st 2nd 3rd 4th

   d. Transistors and symbolic programming languages 1st 2nd 3rd 4th

8. Indicate whether each device below is digital or analog. Use a D for digital and an A for analog.

   a. Automobile odometer ____

   b. Thermometer ____

   c. Oil pressure gauge ____

   d. Adding machine ____

9. List two characteristics for two of the specific sizes of computers - super, large, medium, small, mini, micro. You select the two sizes you wish to use.

10. Match each item in the left column with the correct definition in the right column.

   ____a. Computer Hardware

   ____b. Computer Software

   ____c. Computer Firmware

   1. Read Only Memory

   2. The Central Processing Unit

   3. A program which will add two numbers

11. Briefly discuss how computers are used in five different situations.

BACKGROUND AND USES OF DATA PROCESSING
UNIT I

ANSWERS TO EXAMINATION

1. a. Data processing - converting information into usable form

   b. Input - data that enter system for processing

   c. Microseconds - a millionth of a second

   d. Software - term used to describe programs (instructions) that cause hardware to function

   e. Byte - unit of computer memory which can represent any digit, letter of alphabet, or special character; smallest unit of memory that can have an address

   f. Hardware - term used to describe any physical equipment or components in an electronic computer system

   g. Milliseconds - one-thousandth of a second

   h. Central Processing Unit (CPU) - that part of computer that receives and stores instructions and data, performs arithmetic and logic operations, and directs action of input and output units

   i. K (kilobyte) - usually considered as 1,000 bytes or exactly 1,024 bytes

   j. Computer Assisted Instruction (CAI) - process by which students use computers directly for learning new subjects

   k. Word processing - the production of readable information using efficient management of people, procedures, and equipment

   l. Output - processed information

   m. Terminal - input/output device consisting of typewriter keyboard and printer or display; enables user to have contact with computer.

   n. Languages - different ways of communicating with the computer

2. a. 4
   b. 1
   c. 3
   d. 5
   e. 2

3. c

4. (Any two of the following three:)
   - a. Rapid response
   - b. Fast processing speeds
   - c. Large quantities of data

5. a. 2
   - b. 3
   - c. 1

6. (Any three of the following four:)
   - a. Electronic elements
   - b. Internal storage (Memory)
   - c. Stored programs
   - d. Program modifications

7. a. 1st
   - b. 3rd
   - c. 4th
   - d. 2nd

8. a. D
   - b. A
   - c. A
   - d. D

9. Answers will vary. Select from the list provided in VII.B. of outline in this unit.

10. a. 2
    - b. 3
    - c. 1

11. Answers will vary. Compare with information presented to students in XI of outline in this unit.

INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

UNIT OBJECTIVES

After studying this unit, students should have an understanding and working knowledge of the various types of input and output devices and media, uses of the various devices and media, and the advantages and disadvantages of each.

SPECIFIC OBJECTIVES

After studying this unit, students should be able to:

1. Match terminology with definitions.
2. Distinguish between data input and data output.
3. Describe the function of punched card machines.
4. Distinguish some differences between the 80-column (Hollerith) card and the 96-column card.
5. List advantages and disadvantages of punched card processing.
6. List advantages and disadvantages of punched paper tape processing.
7. List advantages and disadvantages of magnetic tape processing.
8. List advantages and disadvantages of magnetic disk processing.
9. Discuss the advantages and use of the floppy disk.
10. Discuss the use and expense of tape cassettes and cartridges.
11. Discuss the use of the magnetic ink character recognition (MICR).
12. Identify correctly which optical reader is used for a specific activity.
13. Differentiate between the various keyboard machines.
14. Distinguish between page, line, and character printers.
15. Identify devices which can perform both input and output functions.
16. Compare and contrast sequential and random access.
17. Arrange input/output systems according to relative speed.

INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

SUGGESTED ACTIVITIES

I. Instructor

- A. Make transparencies.
- B. Provide students with objectives and discuss.
- C. Provide students with information and assignment sheets and discuss.
- D. Give examination.

II. Student

- A. Read objectives.
- B. Study information sheets as presented and assigned by instructor.
- C. Complete assignment sheets.
- D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit Content

- A. Objectives
- B. Notes to instructor
- C. Information sheets
- D. Transparency masters
  1. TM-II-1: GIGO!
  2. TM-II-2: Some Sources of Information
  3. TM-II-3: Forms of Output
  4. TM-II-4: Brush Type Reader
  5. TM-II-5: Photoelectric Reader
  6. TM-II-6: The 80-Column Card

7. TM-II-7: The 96-Column Card
8. TM-II-8: Magnetic Tape and Tape Device
9. TM-II-9: Magnetic Tape
10. TM-II-10: Seven-Track Tape With Even Parity
11. TM-II-11: Gaps
12. TM-II-12: The Disk Device
13. TM-II-13: A Disk Surface
14. TM-II-14: Disk Tracks
15. TM-II-15: A Check With Magnetic Ink Characters
16. TM-II-16: Original Electronic Scoring Sheet
17. TM-II-17: OCR Fonts
18. TM-II-18: Visual Display Terminals
19. TM-II-19: Output Printers
20. TM-II-20: A Print Drum

E. Assignment sheets

1. AS-II-1: Equipment Speed and Cost
2. AS-II-2: Decoding and Parity
3. AS-II-3: Data Processing Documents
4. AS-II-4: Data Processing Components
5. AS-II-5: Advantages and Disadvantages of Input/Output Media
6. AS-II-6: Recognizing Common Input/Output Media and Devices

F. Answers to assignment sheets

G. Examination

H. Answers to examination

INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

NOTES TO THE INSTRUCTOR

COLLECT!

Companies may be willing to furnish you with defective or discarded media. Students may be able to help collect these materials as a special assignment.

Build a file of examples illustrating problems caused by inaccurate input data. Students can also help with this as a special assignment.

Collect various examples of source documents. Have students examine these to see what kinds of information are recorded.

Companies may have various printed output free for the asking. Use these for illustrations.

If you have only punched card equipment available, you may wish to expand Sections III, IV, and V of the outline. Otherwise, you may wish to de-emphasize punched card and punched paper tape and return to earlier methods of performing data processing. The more exposure students can have to the equipment and applications from this unit, the better they should understand the material.

Transparency 1
Stress the importance of accuracy first, then speed. The most sophisticated calculations do not yield good output if input is inaccurate.

Transparency 11
Emphasize the importance of saving storage space on magnetic tape by blocking records.

INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

INFORMATION SHEET

I. Terms and Definitions

A. Buffer - a storage area designed to hold data temporarily

B. Bytes Per Inch (BPI) - the number of bytes contained per inch of tape media. A byte usually consists of 8 bits.

C. Cathode-Ray Tube (CRT) - a television-like device with screen which displays input and output instead of printing input and output

D. Characters Per Inch (CPI) - the number of characters recorded per inch of media. Each column on a punched card contains one character.

E. Data input - the process of transferring machine readable data into the computer system for processing

F. Data output - the process of producing information and data in a form that is readable and usable by humans or computer input devices

G. Flippies - small floppy disks which record on both sides

H. Floppy disk - small, flexible magnetic platter that is something like a phonograph record. One disk holds as much data as 3,000 eighty-column cards.

I. Microfiche - a rectangular piece of film on which images have been replaced and recorded. One card can hold between 60 and 98 pages of copy.

J. Magnetic Ink Character Reader (MICR) - an input device used to process data printed in magnetic ink with specially designed numbers and symbols

K. Parity - a quality relating to the maintenance of a sameness of level or count, i.e., keeping the same number of binary ones in a computer word to thus be able to perform a check based on an even or odd number for all words under examination

L. Point-of-Sale Terminal (POS) - a device used to record purchases of customers, such as a cash register

M. Optical Character Reader (OCR) - a device that uses optical means to identify graphic characters

N. Random access - a direct method of accessing data regardless of position in file

O. Sequential access - a storage technique in which stored items of data become available only in one-after-the-other sequence, whether all information in record or only some of it is desired

P. Universal Product Code (UPC) - a symbol adopted by the food industry. It is made up of a series of vertical bars that reflect light from an optical scanner. The bars are a coded form of numbers.

II. Distinguish Between Data Input and Data Output.

A. Data input is the process of transferring machine readable data into the computer system for processing.

1. Data must be accurate.

a. GIGO - Garbage In--Garbage Out (Refer to TM-II-1.)

b. Computer has zero IQ (Intelligence Quotient)

c. Verify accuracy

d. Accuracy first, then speed

2. Input may come from different sources. (Refer to TM-II-2.)

a. Obtained from outside the computer system (i.e., source documents)

b. Read from auxiliary storage

B. Data output is the process of producing information and data in a form that is readable and usable by humans or computer input devices. (Refer to TM-II-3.)

1. Some devices used for output and input

2. Output devices operate at different speeds.

3. Output may be in different forms.

a. Displayed

b. Printed on computer paper

c. Printed on special forms

d. Microfilm, microfiche

e. Magnetic disk or tape

III. Punched Card Equipment (Unit Record Equipment) and Operations

- A. Keypunch machine
  1. Operator keys data from source documents.
  2. Machine punches rectangular holes in cards.
  3. By using a program drum, keypunch machines can be controlled to automatically space, skip, duplicate, or punch alpha or numeric characters.
  4. Keypunch machines may be portable.
  5. Holes can be punched in special cards with a stylus.
  6. Some keypunch machines use buffers.
     - a. Buffers permit temporary storage.
     - b. Enables operator to verify accuracy of keystrokes
     - c. Operator backspaces and strikes over errors to correct.
     - d. Cards punched when data is correct
- B. Card verifier
  1. Used to check accuracy of previously punched data
  2. Resembles keypunch machine
     - a. Punched cards are fed into verifier and data from source documents is rekeyed.
     - b. Card is notched to show error location if punched data and keyed data disagree.
- C. Card reader, reader-punch (Refer to TM-II-4, TM-II-5, and AS-II-1.)
  1. Reader reads punched cards for computer input.
  2. Punch punches data in cards for computer output.
- D. Card sorter
  1. Sorts punched cards numerically and alphabetically
  2. Reads one column punch at a time

E. Card collator

1. Merges cards - combines two files into one

2. Matches cards - compares for equality of specific fields in records

3. Match-merges - merges matched records

4. Sequence checks - checks previously sequenced records to insure that sequencing is correct

F. Card interpreter

1. Used when punched cards have not been printed

2. Reads holes in punched cards and prints data at top of card

IV. Punched Card Media

A. Hollerith card (Refer to TM-II-6.)

1. 80 numbered vertical columns

2. 12 horizontal rows

3. Zone punch area

a. 12 row

b. 11 row

c. Zero (0) row

4. Digit punch area

a. 0 row through 9 row

b. 0 row either zone or digit punch

5. Letters represented by one zone and one digit punch per column (Refer to AS-II-2.)

a. A-I

1) Zone punch in 12 row
2) Digit punch in 1-9 row

b. J-R

1) Zone punch in 11 row
2) Digit punch in 1-9 row

    c. S-Z

        1) Zone punch in 0 row
        2) Digit punch in 2-9 row

6. Numbers represented by one punch per column

7. Special characters

    a. 1, 2, or 3 punches per column

    b. Use zone and/or digit areas

8. Corner slash useful for humans

9. Color coding useful for humans

10. Special types of punched cards (Refer to AS-II-3.)

    a. Tumble card

        1) 40 columns on each end
        2) Reverse card to utilize space

    b. Dual card

        1) Write information on card
        2) Punch written data into same card

    c. Porta-punch card

        1) Hole area scored
        2) Punch out hole with stylus or pen

    d. Mark sense card

        1) Darken area with soft pencil
        2) Read by special reader

    e. Check card

        1) Data punched into card
        2) Serves as payroll check for employees

    f. Stub card

        1) Tear off stub
        2) "Keep this--Return this"

    g. Microfilm card

        1) Punch area
        2) Microfilm

B. 96-column card (Refer to TM-II-7.)

   1. Smaller than 80-column card

   2. Records data more compactly than 80-column card

   3. Contain 3 tiers of rows

   4. Contains 32 columns per row

   5. Uses Binary Coded Decimal (BCD) code

      a. 6 position code

         1) A and B rows are zone punches.
         2) 1, 2, 4, 8 rows are digit punches.

      b. May require more holes per column to represent characters

      c. A-I

         1) Zone punch in B and A rows
         2) 1 or more digit punches

      d. J-R

         1) Zone punch in B row
         2) 1 or more digit punches

      e. S-Z

         1) Zone punch in A row
         2) 1 or more digit punches

      f. Numbers

         1) Zero in A row
         2) 1 or more digit punches for 1-9

      g. Special characters

         1) 1 to 6 punches
         2) Uses zone and/or digit areas

V. Advantages and Disadvantages of Punched Card Processing

A. Advantages

   1. Printed data can be read by anyone.

   2. Data cannot be accidentally erased.

3. Equipment is inexpensive and easy to use.
4. Verified cards provide permanent record.
5. Cards can serve as business documents.
6. Each record is a unit.
7. Card format is similar to magnetic media.

B. Disadvantages

1. Cards are not reusable for different data.
2. Cards require reader to feed data--slow process.
3. Cards require considerable storage space.
4. Cards have fixed length - 80 or 96 columns.
5. Cards can be easily damaged.
6. Cards require people to handle them.
7. Entry errors require punching of new card.
8. Cards provide poor file integrity and are expensive.

VI. Punched Paper Tape

A. Devices

1. Data represented by holes punched in paper tape
2. Paper tape read by special paper tape reader for input
3. Paper may be punched during other operations
    a. Cash register punches tape as sales are recorded.
    b. Typewriter terminals punch paper tape as data are keyed.
    c. Computer can output to a paper tape punch.

B. Media

1. Punched paper tape is similar to punched cards in operations.
2. Uses BCD code to represent data
3. Uses additional row for parity to check accuracy

        a. Odd parity - total number of holes per column is odd number (1, 3, 5, 7)
        b. Even parity - total number of holes per column is even number (2, 4, 6)
    4. Mylar punched tape is replacing paper tape.

  C. Advantages and disadvantages of punched paper processing (Refer to AS-II-4.)

    1. Advantages
        a. Inexpensive
        b. Versatile
        c. Speed about the same as punched card
    2. Disadvantages
        a. Corrections are difficult to make without completely repunching.
        b. Paper tape is not durable.
        c. Difficult to sort and collate data
        d. Slow compared to magnetic media
        e. Paper tape cannot be reused for different data.

VII. Magnetic Tape (Refer to TM-II-8.)

  A. Drive

    1. Used for input or output
    2. Reads or records faster than card or paper devices

  B. Media (Refer to TM-II-9 and TM-II-10.)

    1. Tape may be on reels, in cassettes, or cartridges.
    2. Tape reel holds about 2,400 ft. of 1/2 inch tape.
    3. Tape is coated with magnetically sensitive material.
    4. Data is recorded as magnetic spots according to a code.
    5. Data recorded on tape in sequence (sequential access)
        a. Must read or write records one after the other
        b. Must read entire tape to read record at end of tape

6. Data transfer rate (50,000 to 1,000,000 characters per second) (Refer to AS-II-5.)

    a. Tape speed measured in inches per second

    b. Tape density is number of frames per inch.

        1) CPI - characters per inch
        2) BPI - bytes per inch

7. Interrecord gap (IRG)

    a. Approximately 1/2 inch long (Refer to TM-II-11.)

    b. Reel of tape must start and stop in IRG space.

    c. Can read or write only if tape rotates at constant speed (Refer to AS-II-6a.)

8. Interblock gap (IBG)

    a. Several records blocked into one physical record

    b. Blocking factor (number of records blocked) may vary.

    c. Reduces space consumed by IRG

    d. Speed reading and writing processes (Refer to AS-II-6b.)

C. Advantages and disadvantages of magnetic tape processing

1. Advantages

    a. Faster entry and output than cards or punched paper tape

    b. Record length not limited

    c. Data revision easier than card or paper tape

    d. Entry machines quieter than keypunch

    e. Fewer steps decrease error possibility.

    f. Tape more durable than cards or paper tape

    g. Can reuse tape for different data

    h. Requires less physical storage space than cards

    i. Greater storage capacity than cards or tape

2. Disadvantages

   a. More expensive devices and media than cards or paper tape

   b. More difficult to store and organize than cards

   c. Requires use of backup in case tape is damaged

   d. Stored material is limited to sequential access.

   e. Stored data can only be read by machine.

   f. Possible to accidentally erase data--file protection ring reduces error possibility. When file protection ring is in place on tape reel, file can be read.

   g. Magnetic tape devices and media more expensive than cards or paper tape

   h. Tape reels require special storage facilities.

VIII. Magnetic Disk

A. Drive

1. Random (direct) access

   a. Any record can be accessed directly when needed.

   b. Read/write head moves directly to desired record.

2. Two basic types of magnetic disk drive (Refer to TM-II-12.)

   a. Removable disk

      1) Several access arms for accessing stacked disk plates
      2) Two read/write heads per arm to read from or write on surface above and below arm
      3) Seek time - time required to position access arm
      4) Rotational delay - time required to rotate disk to desired record

   b. Fixed disk

      1) No moving access arm
      2) Large number of read/write heads - one head

for each disk track
    3) Less capacity and higher cost than moving head
    4) Faster access time because seek time is eliminated

B. Media (Refer to TM-II-13 and TM-II-14.)

1. Thin circular plates

2. Plates coated on both sides with magnetically sensitive material

3. Data recorded as magnetized spots

4. Disk pack contains several plates.

5. Data recorded in code on both sides of plates

6. No recording on top or bottom plate of disk pack

7. Data recorded along tracks

C. Advantages and disadvantages of magnetic disk processing

1. Advantages

    a. Random or sequential access

    b. Faster than magnetic tape (100,000 to 300,000 characters per second)

    c. Transactions can be processed as they occur.

    d. Disks can be reused for different data.

2. Disadvantages

    a. Disks are relatively expensive.

    b. Errors are not easily traced.

    c. Not as efficient as magnetic tape for sequential records

IX. Floppy Disk (diskette)

A. Flexible disk similar to LP records

B. Less expensive disk media than magnetic disk

C. Used with smaller computer systems (micro, mini)

D. Flippies - small floppy disks which record on both sides

E. Advantages

  1. Provides affordable storage for smaller systems

    a. On-line - connected to computer and controlled by the CPU

    b. Off-line - not connected to a computer system, but accessible

  2. Storage is much faster and more compact than cards.

  3. Other advantages much the same as magnetic disks

F. Disadvantages - same as magnetic disks

X. Tape Cassettes and Cartridges

A. Useful with micro and mini systems

B. Less expensive than magnetic tape

C. Data transfer rate lower than other media

XI. Magnetic Ink Character Reader (MICR) (Refer to TM-II-15.)

A. Developed to assist banking industry with processing checks

B. Checks and documents imprinted with magnetic ink

C. Numbers, letters, and symbols have special type font.

D. Characters on lower left side are imprinted before check is given depositor.

E. Characters on lower right side

  1. Imprinted after check is written and paid by bank

  2. Characters include check amount.

F. Reader compares characters with special pattern--matrix.

G. Sorter sorts checks by account number to return to depositor.

H. MICR also used in retailing

  1. Price tickets contain price and product information.

  2. Tickets processed by MICR system

XII. Optical Readers

A. Optical mark reader (Refer to TM-II-16.)

  1. Input device reads pencil marks from paper media.
  2. Useful for scoring examinations
  3. Data collected away from computer input devices
  4. Stray marks may be read as data.
  5. Relatively slow processing time

B. Optical bar reader

  1. Reads marks in bar codes
  2. Universal Product Code (UPC) most common bar code

0 16000 10640

  3. UPC code imprinted on most items sold in retail stores
  4. UPC simplifies customer checkout and inventory control.
  5. Point-of-Sale terminals (POS)
     a. Laser beam scanner is used to read code.
     b. Portable laser wand may be used to read code on larger items.

C. Optical character reader (OCR) (Refer to TM-II-17.)

  1. Detects characters by using optical scanning mechanism
  2. Characters printed in special type fonts
  3. May read from paper tape
     a. Cash register tape
     b. Adding machine tape
  4. Reads data imprinted by plastic credit card devices
  5. U.S. Post Office uses OCR to read and sort bulk mail.

    6. Page readers
        a. Insurance forms
        b. Employment and loan applications
        c. Registration forms
        d. Word processing systems
  D. Characteristics of optical reader devices and media
    1. Machines are expensive.
    2. Forms and characters must be precise.
    3. Comparatively slow input

XIII. Keyboard Machines
  A. Require human interaction
  B. Computer console
    1. Typewriter-like device
    2. Located in computer center
    3. On-line to computer
    4. Enables direct communication between operator and computer
  C. Remote terminals (Refer to TM-II-18.)
    1. Typewriter-like device
    2. May print or display (Cathode Ray Tube - CRT) data
    3. May be on-line or off-line
    4. Off-line terminal may utilize telephone hookup to computer.
    5. "Dumb" terminal - transmits and receives data only
    6. Intelligent ("smart") terminal
        a. Capacity to process
        b. Can be programmed
            1) Calculates

79

            2) Edits
            3) Verifies

   D. Key-to-tape devices record data on magnetic tape for input.

   E. Key-to-disk or diskette devices record data on magnetic disk for input.

   F. Keyboard machines slow for input because of human factor

XIV. Output Printers (Refer to TM-II-19.)

   A. Impact printers - hammers strike ribbon against paper to print characters

      1. Character printer

         a. Prints one character at a time

         b. Slowest type of printer

         c. Used for smaller computer systems

         d. Speed usually 40, 80 or 120 cps

      2. Line printer

         a. Used for high volume paper output

         b. Appears to print a line at a time (132 characters)

            1) Drum printer (Refer to TM-II-20.)
               a) Solid drum rotates.
               b) Characters per row same as print positions on printer paper
            2) Chain printer
               a) Contains several sets of characters
               b) Several characters printed with each revolution of chain

   B. Nonimpact printers (page printers)

      1. Electrostatic - process by which electrically charged pins in matrix forms characters on chemically-treated paper

      2. Electrothermal - process by which heated elements create characters as matrices of small dots on heat-sensitive paper

      3. Ink jet printer - a printer from which electronically charged magnetic ink is sprayed onto surface of paper through a matrix.

4. Laser beam

   a. Electrophotographic techniques and laser beams create printed output.

   b. Fastest printers - up to approximately 20,000 lines per minute

XV. Computer Output Microfilm (COM)

   A. Records stored on rolls of microfilm or microfiche frames

   B. Characters may be 48 times smaller than conventional printed characters.

   C. Data retrieved by manually or automatically operated viewers

   D. Useful for locating inventory items

   E. Requires high initial investment

   F. Delays may be found in retrieving data.

   G. COM advantageous for volume of 500,000 pages and over per month

XVI. Digital Devices

   A. Digital input devices (digitizers)

      1. Convert graphic and pictorial data into numeric inputs to digital computers

      2. Drawing or picture reproduced by signals related to x and y coordinates

      3. Image scan digitizers scan and reproduce drawing or picture automatically.

         a. Detects empty or filled areas

         b. Distinguishes intensity of filled areas

   B. Digital output devices

      1. Convert numeric data in computer into graphics or pictures

      2. Produce complex line drawings without aid of a draftsperson

      3. Video terminals can display graphic output.

         a. Light pen - photosensitive penlike instrument

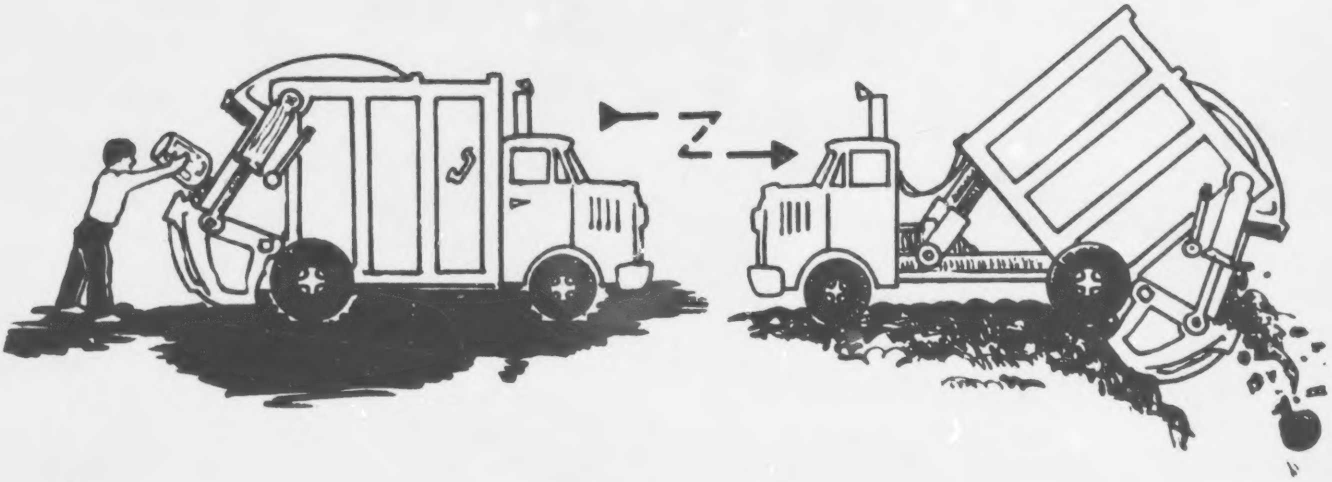
        b. Operator can create or change design drawings.

XVII. Voice Recognition and Response

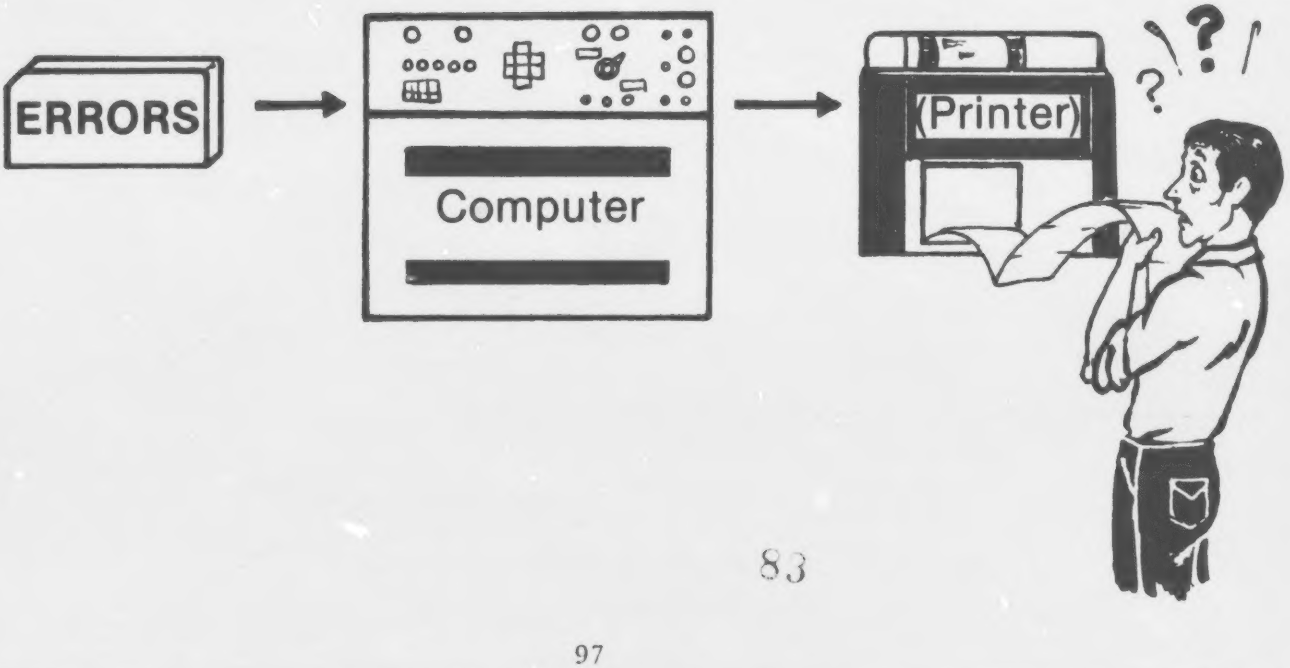
- A. Uses prerecorded message to respond to telephone inquiries
- B. Systems are capable of recognizing voice input on a limited basis.
- C. Research being done to perfect this method for inputting data

TM-II-1

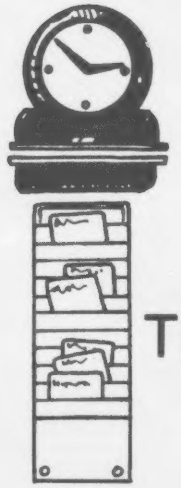
GIGO!



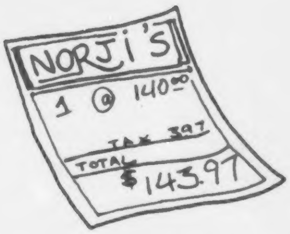
Garbage In = Garbage Out


ERRORS
Computer
(Printer)
?
?

Some Sources of Information

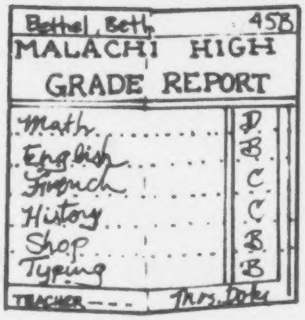


Time cards


NORJI'S
1 @ 140.00
TAX 3.97
TOTAL
$143.97

Sales slips

Grade reports



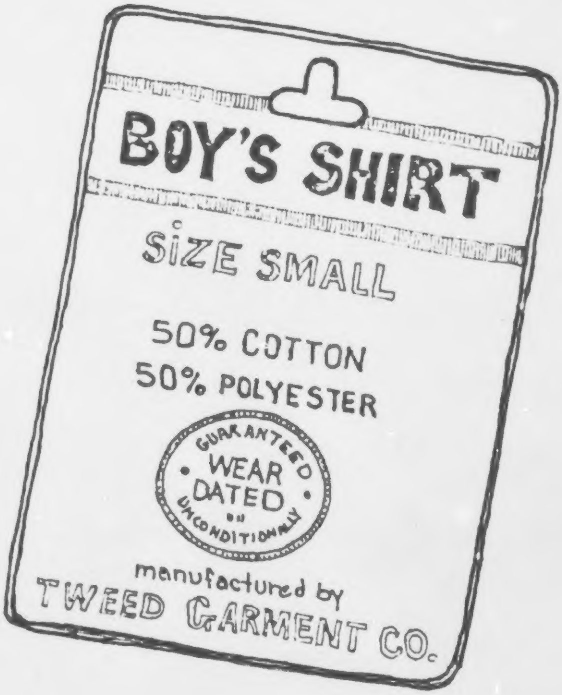
Bethel, Beth 458

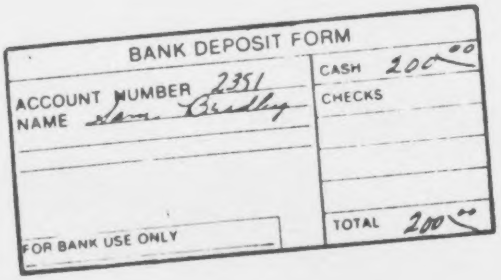
MALACHI HIGH

GRADE REPORT

Math	D
English	B
French	C
History	C
Shop	B
Typing	B
TEACHER	Mrs. Doke

Merchandise tags


BOY'S SHIRT
SIZE SMALL
50% COTTON
50% POLYESTER
GUARANTEED UNCONDITIONALLY
WEAR DATED
manufactured by
TWEED GARMENT CO.



BANK DEPOSIT FORM

ACCOUNT NUMBER 2351

NAME Sam Bradley

CASH 200.00

CHECKS

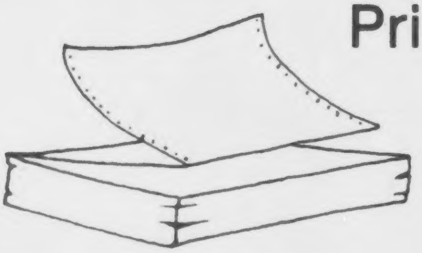
TOTAL 200.00

FOR BANK USE ONLY

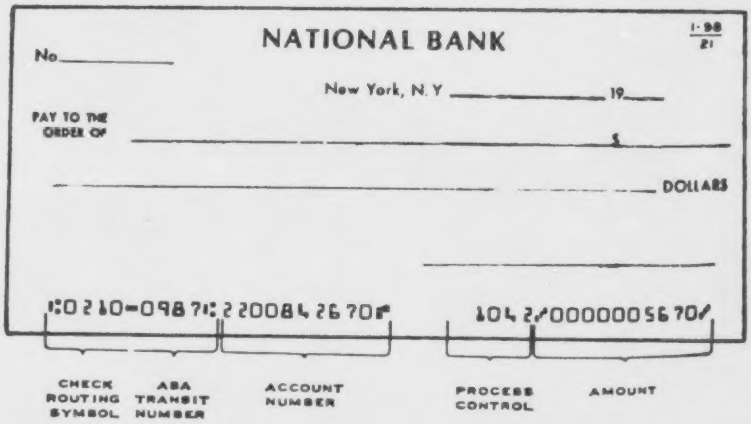
Bank deposit slips

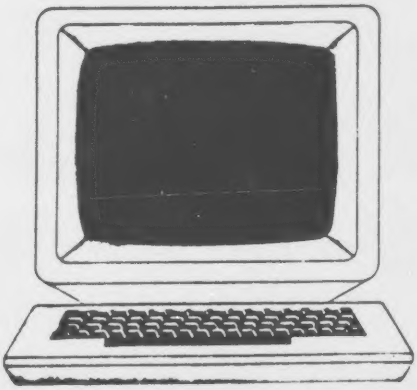
Forms of Output

Printed reports



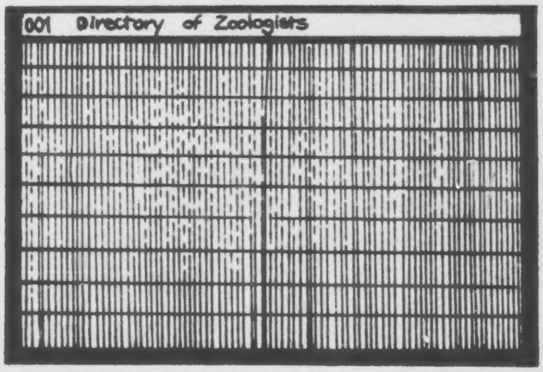
Checks


NATIONAL BANK
1-98
21
No.
New York, N.Y
19
PAY TO THE ORDER OF
$
DOLLARS
⑆0210⑈0987⑆ 2 20084 2670⑈
1042⑈0000005670⑈
CHECK ROUTING SYMBOL
ABA TRANSIT NUMBER
ACCOUNT NUMBER
PROCESS CONTROL
AMOUNT



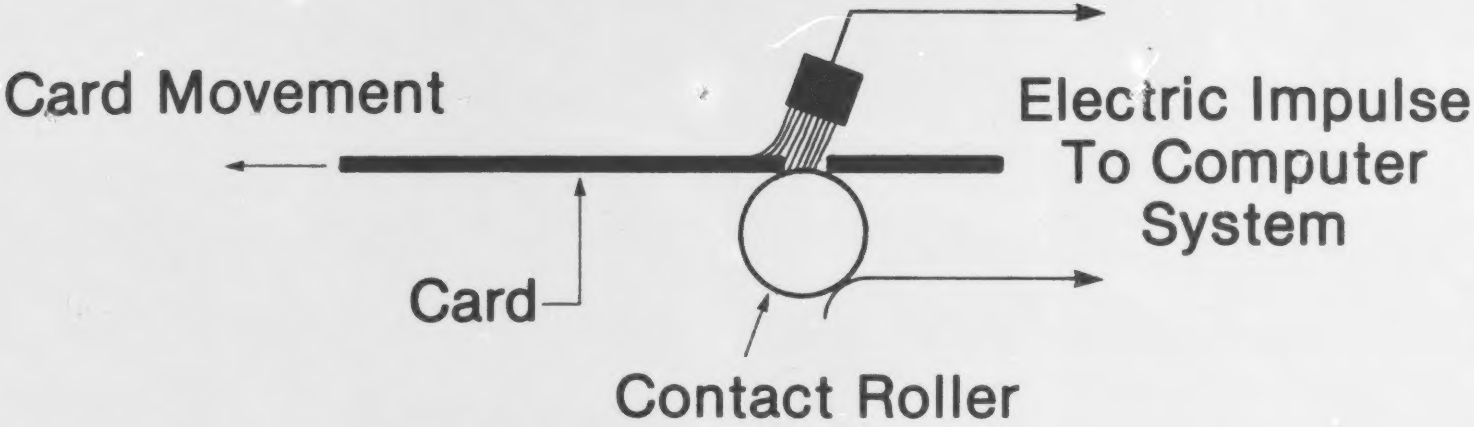
Visual

Microfiche


001 Directory of Zoologists

Microfilm

Brush Type Reader



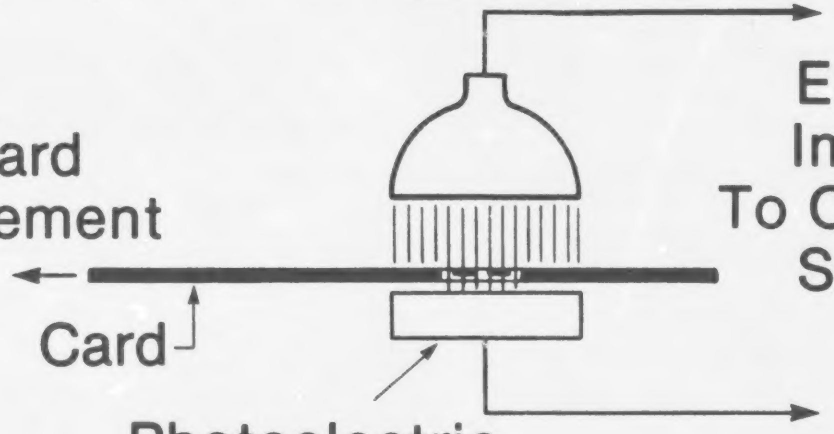
Card Movement

Electric Impulse
To Computer
System

Card

Contact Roller

Photoelectric Reader



Light Source

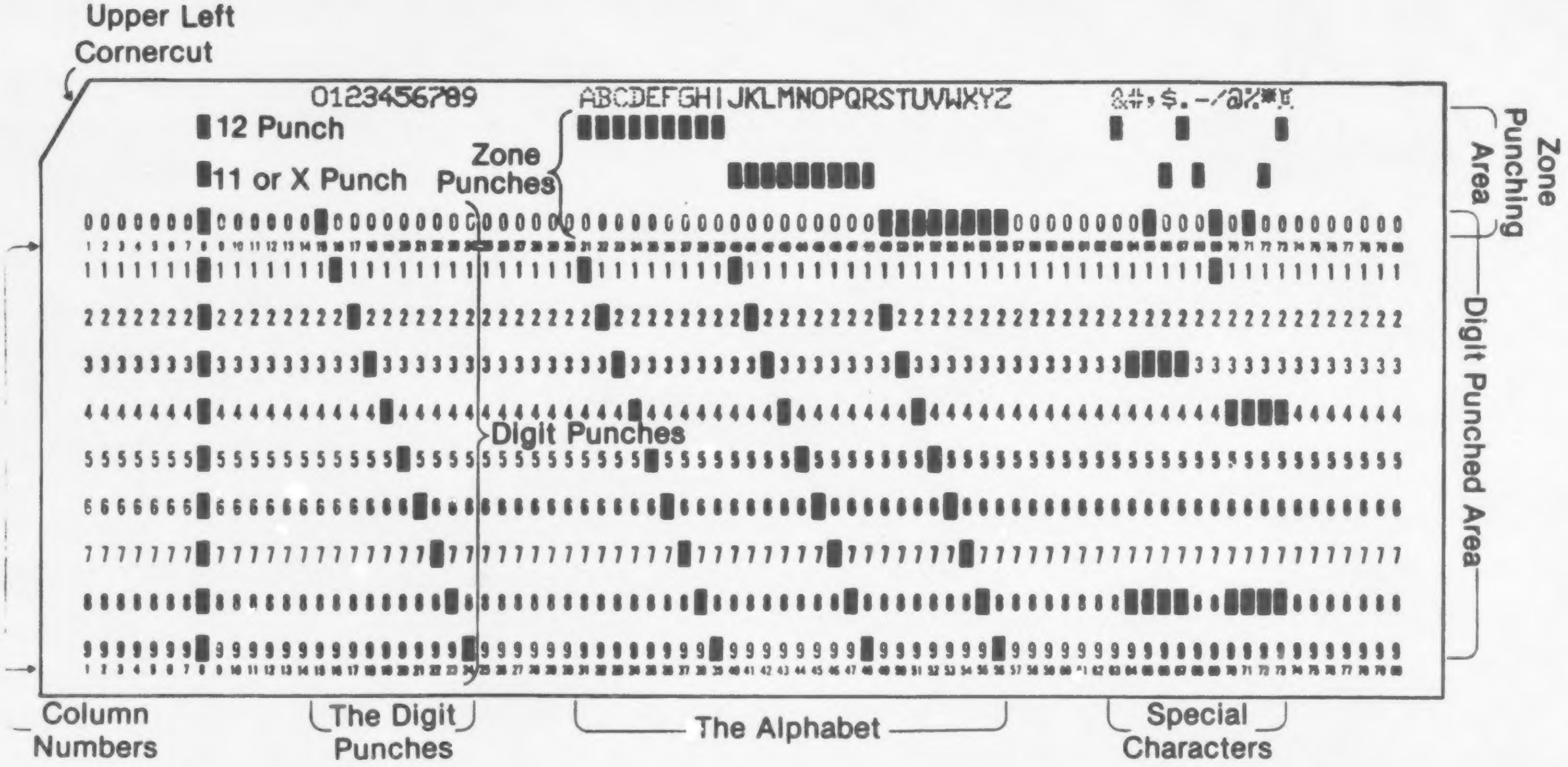
Electric Impulse To Computer System

Card Movement

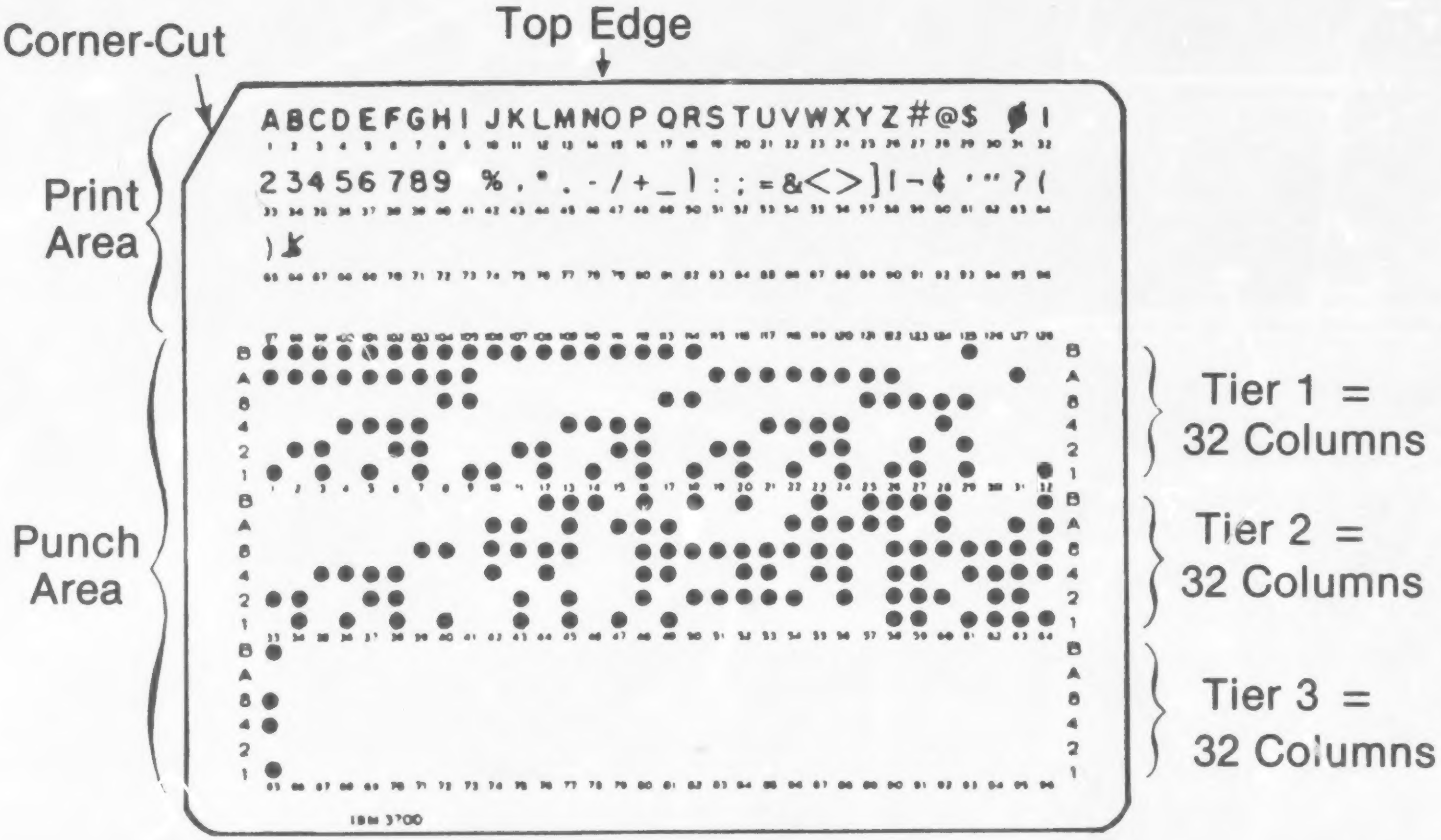
Card

Photoelectric Cell

The 80-Column Card

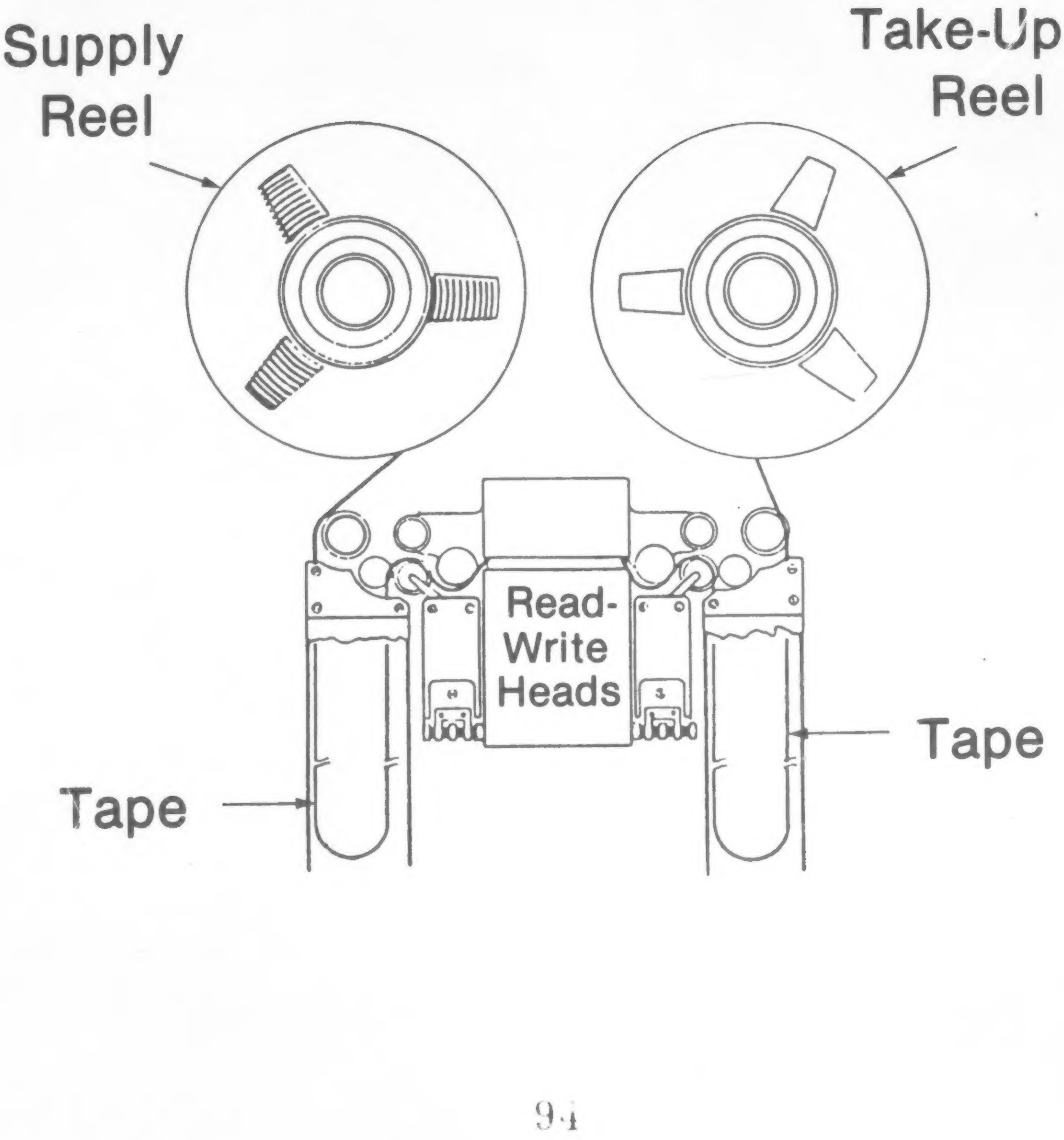

Upper Left Cornercut
0123456789
ABCDEFGHIJKLMNOPQRSTUVWXYZ
&#,$.-/@%*¤
12 Punch
11 or X Punch
Zone Punches
Digit Punches
Zone Punching Area
Digit Punched Area
Column Numbers
The Digit Punches
The Alphabet
Special Characters

The 96-Column Card

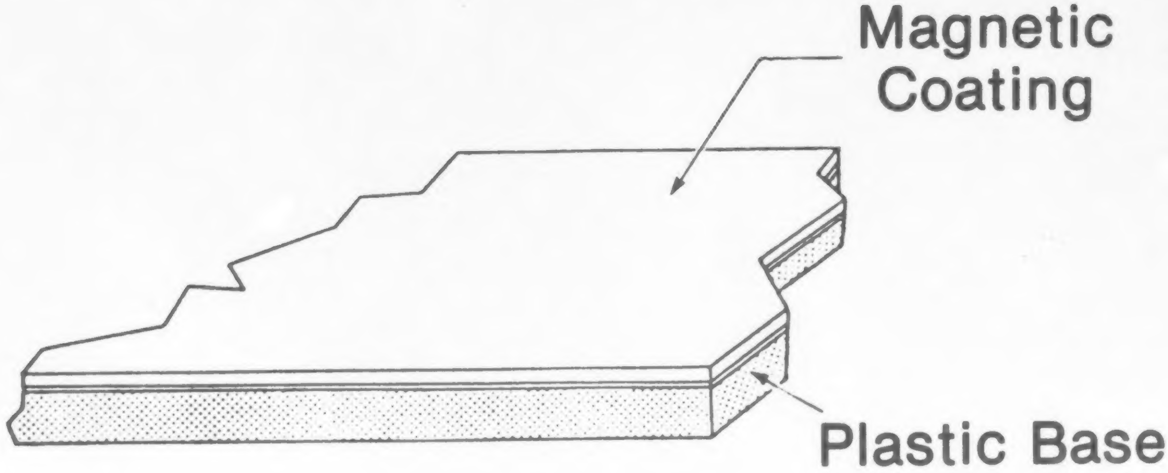

Top Edge
Corner-Cut
Print Area
Punch Area
Tier 1 = 32 Columns
Tier 2 = 32 Columns
Tier 3 = 32 Columns
ABCDEFGHI JKLMNOPQRSTUVWXYZ#@$ ¢ !
23456789 %,*.-/+_):;=&<>]|¬¢'"?(
)
B
A
8
4
2
1
IBM 3700

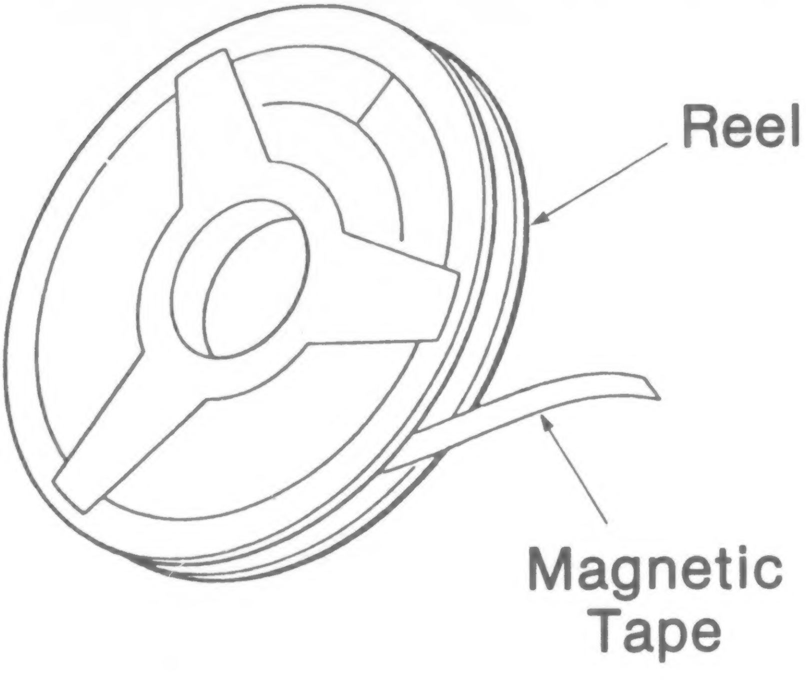
Developed by IBM, 1969
Smaller, more data

Magnetic Tape And Tape Device

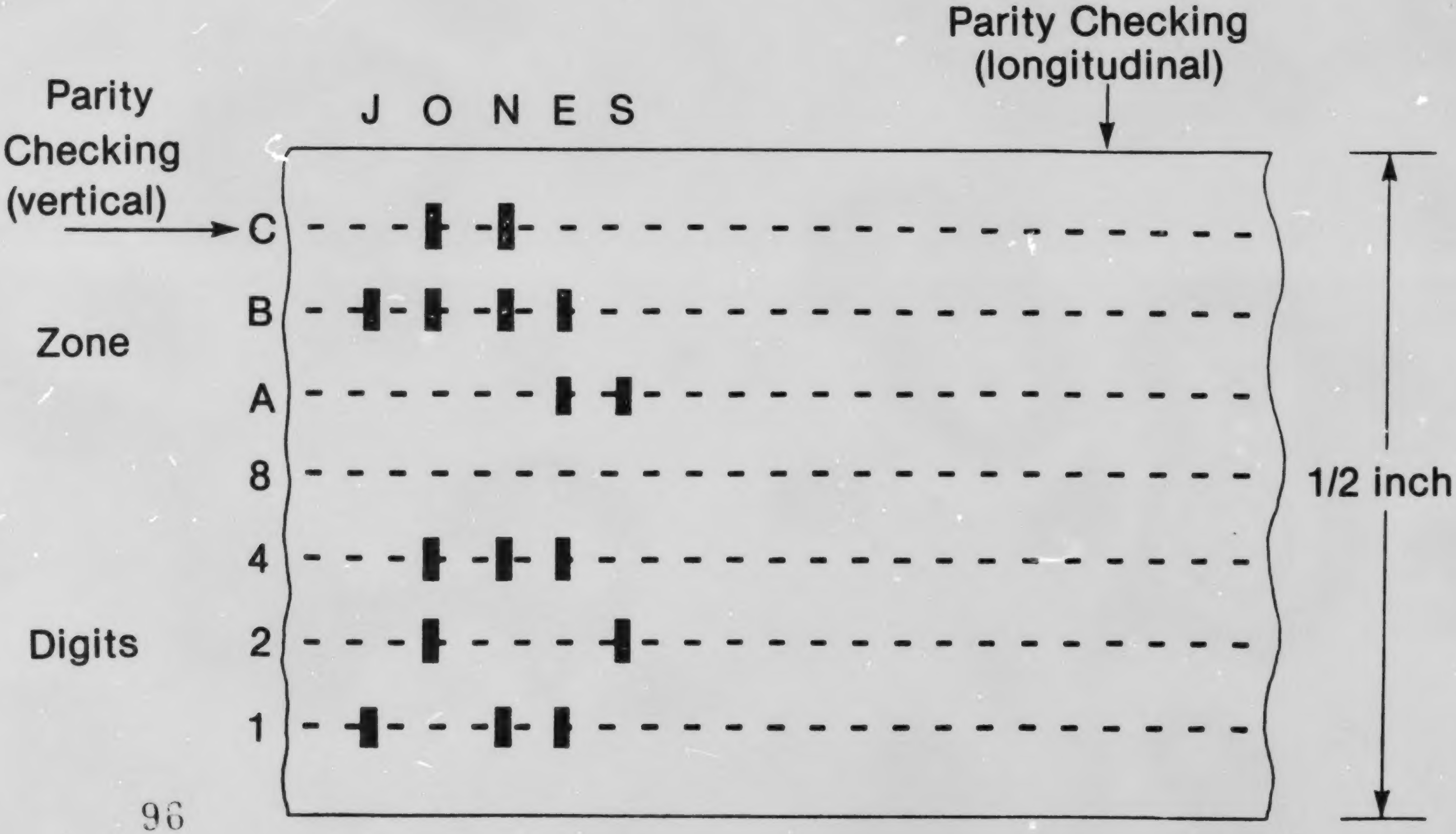

Supply
Reel
Take-Up
Reel
Read-
Write
Heads
Tape
Tape

Magnetic Tape


Magnetic
Coating
Plastic Base


Reel
Magnetic
Tape

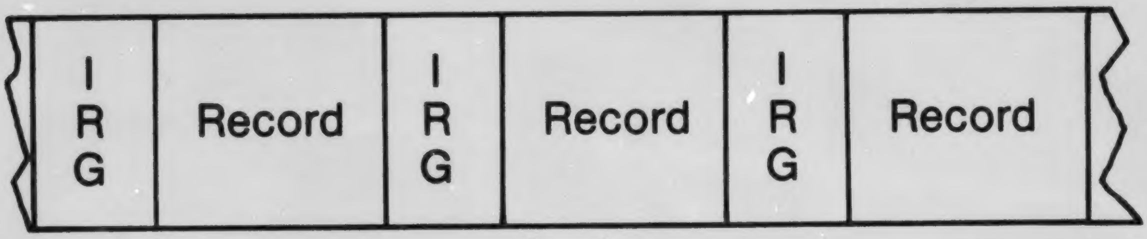
7-Track Tape With Even Parity


Parity Checking (longitudinal)
Parity Checking (vertical)
J O N E S
C
B
Zone
A
8
4
Digits
2
1
1/2 inch

TM-II-10

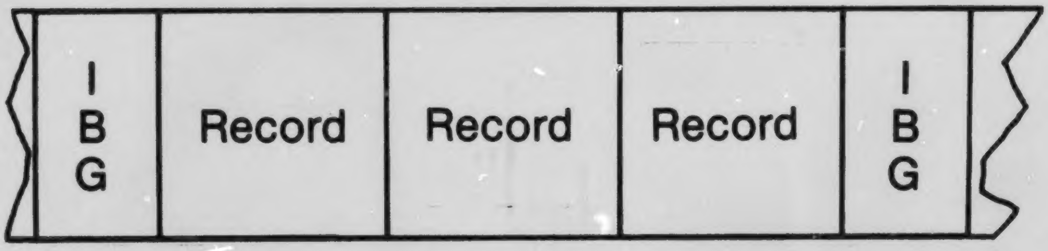
Gaps

Interrecord Gap (IRG)


IRG
Record
IRG
Record
IRG
Record

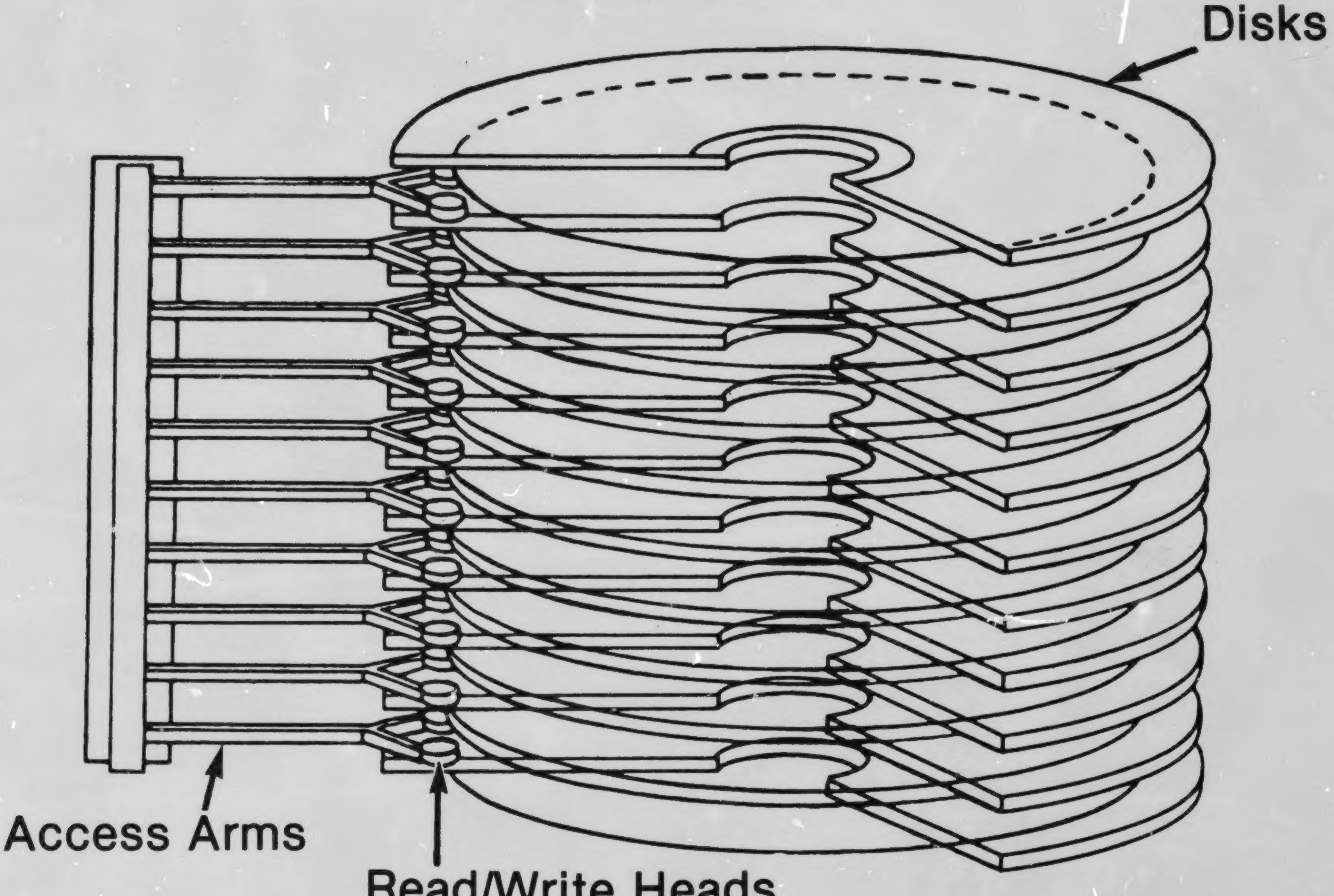
Single Record

Interblock Gap (IBG)

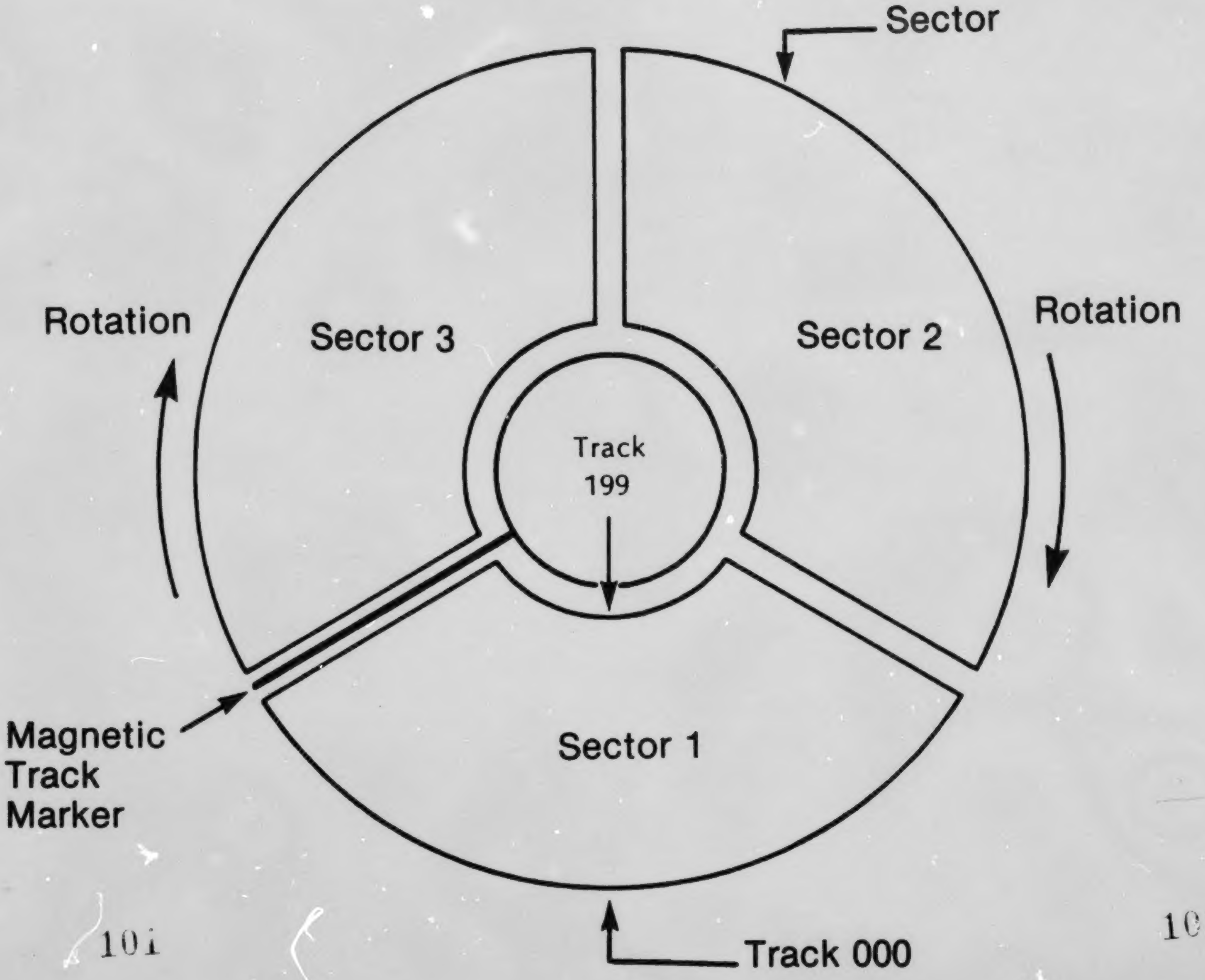

IBG
Record
Record
Record
IBG

Multiple Record (A Block of Records)

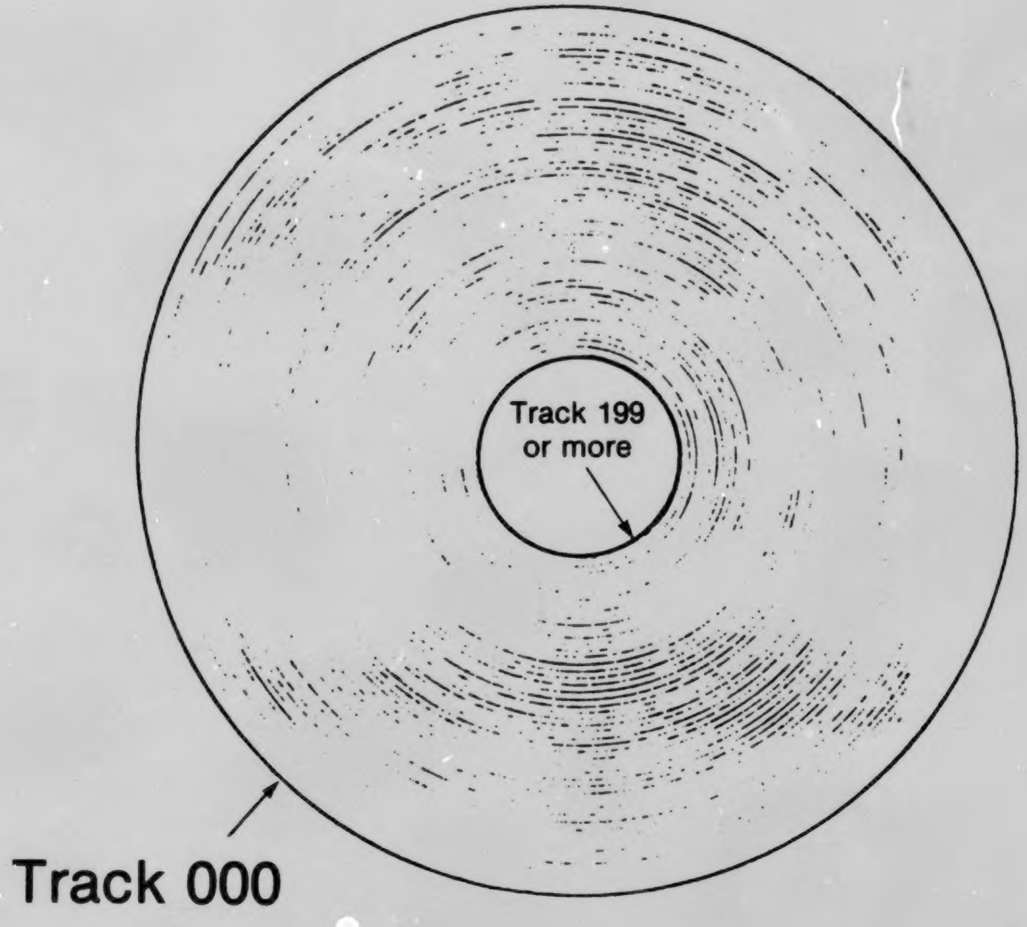
The Disk Device


Disks
Access Arms
Read/Write Heads

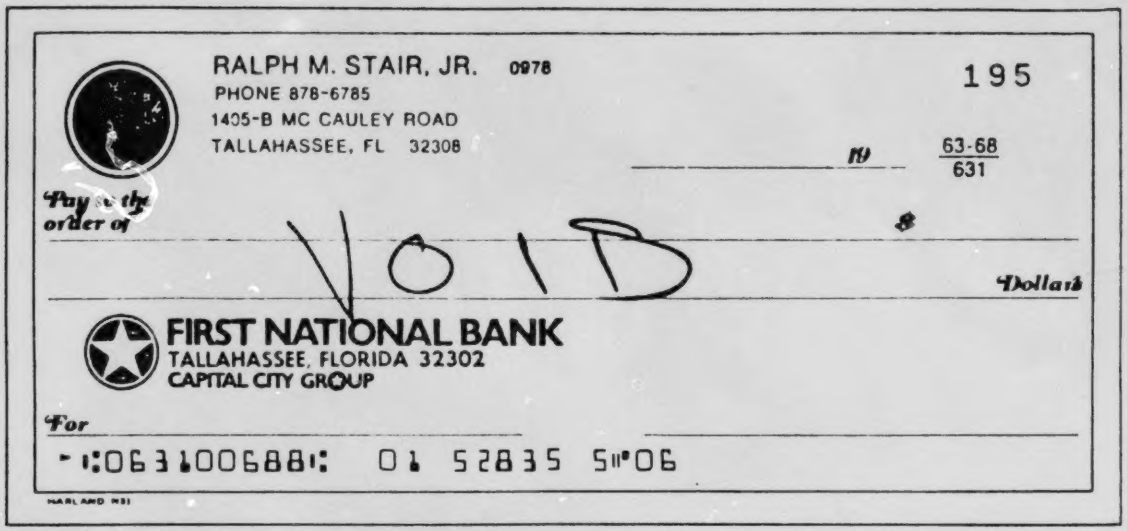
A Disk Surface


Sector
Rotation
Sector 3
Sector 2
Rotation
Track
199
Magnetic
Track
Marker
Sector 1
Track 000

Disk Tracks


Track 199
or more
Track 000

A Check With Magnetic Ink Characters



RALPH M. STAIR, JR. 0978
PHONE 878-6785
1405-B MC CAULEY ROAD
TALLAHASSEE, FL 32308

195

19

63-68
631

Pay to the order of $

VOID

Dollars

FIRST NATIONAL BANK
TALLAHASSEE, FLORIDA 32302
CAPITAL CITY GROUP

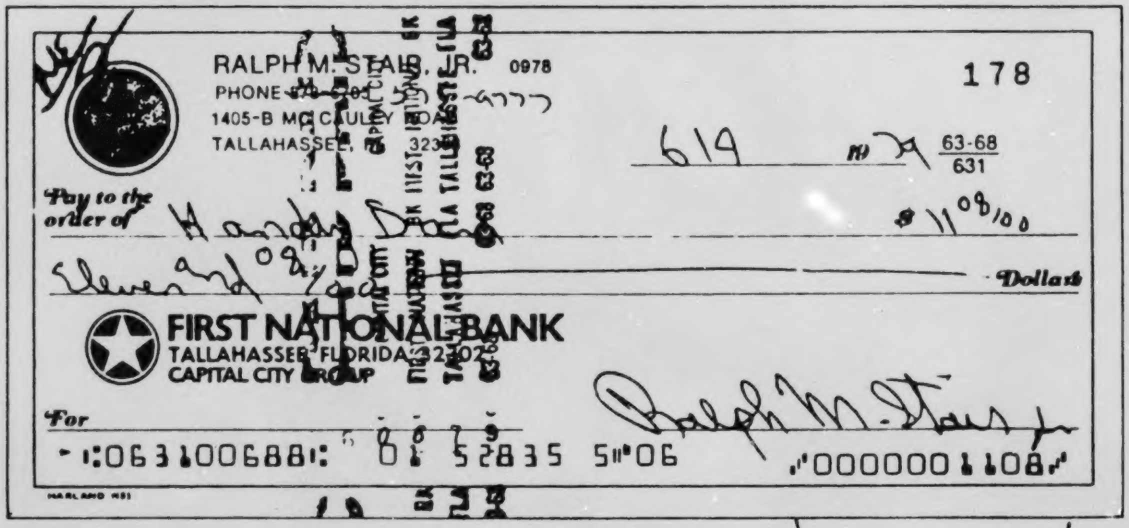
For

⑆063100688⑆ 01 52835 5⑈06

HARLAND H31

Account

Blank Check



RALPH M. STAIR, JR. 0978
PHONE 878-6785
1405-B MC CAULEY ROAD
TALLAHASSEE, FL 32308

178

6/19 19 79

63-68
631

Pay to the order of Handy Dr[illegible] $ 11 08/100

Eleven and 08/100 Dollars

FIRST NATIONAL BANK
TALLAHASSEE, FLORIDA 32302
CAPITAL CITY GROUP

For

Ralph M. Stair Jr.

⑆063100688⑆ 01 52835 5⑈06 ⑆0000001108⑆

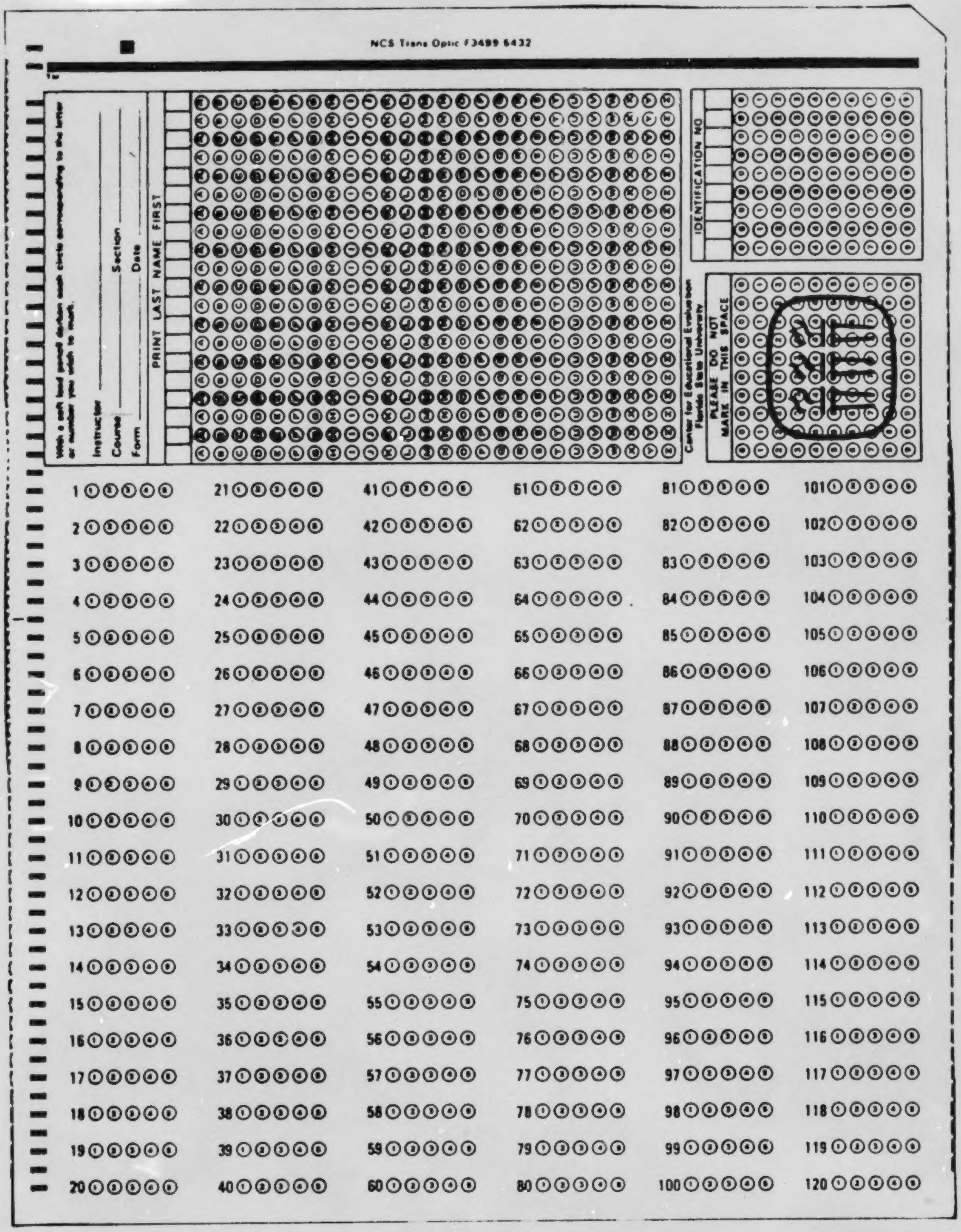
HARLAND H31

Processed Check

The Amount Is
$11.08

TM-II-16

Original Electronic Scoring Sheet



NCS Trans Optic F3499 6432

With a soft lead pencil darken each circle corresponding to the letter or number you wish to mark.

Instructor ______ Section ______

Course ______ Date ______

Form ______

PRINT LAST NAME FIRST

IDENTIFICATION NO

Center for Educational Evaluation
Florida State University

PLEASE DO NOT MARK IN THIS SPACE

1 ①②③④⑤	21 ①②③④⑤	41 ①②③④⑤	61 ①②③④⑤	81 ①②③④⑤	101 ①②③④⑤
2 ①②③④⑤	22 ①②③④⑤	42 ①②③④⑤	62 ①②③④⑤	82 ①②③④⑤	102 ①②③④⑤
3 ①②③④⑤	23 ①②③④⑤	43 ①②③④⑤	63 ①②③④⑤	83 ①②③④⑤	103 ①②③④⑤
4 ①②③④⑤	24 ①②③④⑤	44 ①②③④⑤	64 ①②③④⑤	84 ①②③④⑤	104 ①②③④⑤
5 ①②③④⑤	25 ①②③④⑤	45 ①②③④⑤	65 ①②③④⑤	85 ①②③④⑤	105 ①②③④⑤
6 ①②③④⑤	26 ①②③④⑤	46 ①②③④⑤	66 ①②③④⑤	86 ①②③④⑤	106 ①②③④⑤
7 ①②③④⑤	27 ①②③④⑤	47 ①②③④⑤	67 ①②③④⑤	87 ①②③④⑤	107 ①②③④⑤
8 ①②③④⑤	28 ①②③④⑤	48 ①②③④⑤	68 ①②③④⑤	88 ①②③④⑤	108 ①②③④⑤
9 ①②③④⑤	29 ①②③④⑤	49 ①②③④⑤	69 ①②③④⑤	89 ①②③④⑤	109 ①②③④⑤
10 ①②③④⑤	30 ①②③④⑤	50 ①②③④⑤	70 ①②③④⑤	90 ①②③④⑤	110 ①②③④⑤
11 ①②③④⑤	31 ①②③④⑤	51 ①②③④⑤	71 ①②③④⑤	91 ①②③④⑤	111 ①②③④⑤
12 ①②③④⑤	32 ①②③④⑤	52 ①②③④⑤	72 ①②③④⑤	92 ①②③④⑤	112 ①②③④⑤
13 ①②③④⑤	33 ①②③④⑤	53 ①②③④⑤	73 ①②③④⑤	93 ①②③④⑤	113 ①②③④⑤
14 ①②③④⑤	34 ①②③④⑤	54 ①②③④⑤	74 ①②③④⑤	94 ①②③④⑤	114 ①②③④⑤
15 ①②③④⑤	35 ①②③④⑤	55 ①②③④⑤	75 ①②③④⑤	95 ①②③④⑤	115 ①②③④⑤
16 ①②③④⑤	36 ①②③④⑤	56 ①②③④⑤	76 ①②③④⑤	96 ①②③④⑤	116 ①②③④⑤
17 ①②③④⑤	37 ①②③④⑤	57 ①②③④⑤	77 ①②③④⑤	97 ①②③④⑤	117 ①②③④⑤
18 ①②③④⑤	38 ①②③④⑤	58 ①②③④⑤	78 ①②③④⑤	98 ①②③④⑤	118 ①②③④⑤
19 ①②③④⑤	39 ①②③④⑤	59 ①②③④⑤	79 ①②③④⑤	99 ①②③④⑤	119 ①②③④⑤
20 ①②③④⑤	40 ①②③④⑤	60 ①②③④⑤	80 ①②③④⑤	100 ①②③④⑤	120 ①②③④⑤

OCR Fonts

OCR A Alphanumeric

0123456789
ABCDEFGHIJKLMNOPQRSTUVWXYZ
{}%?&"*+$,.-/'=|;:█

Farrington 7B

0123456789 EPH̄

E13B (MICR)

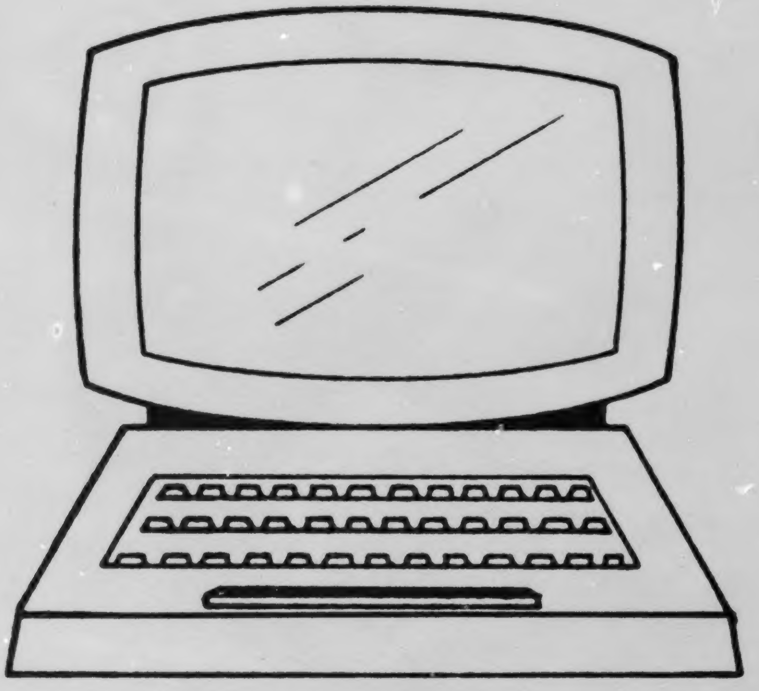
0123456789⑆⑇⑈⑉

~~107~~ 108

Visual Display Terminals

Cathode Ray Tube
(CRT)

1. Alphanumeric
2. Graphical



Soft Copy

Output Printers

Impact vs. Non-Impact

Character-At-A-Time
(Serial Printers)

Line-At-A-Time

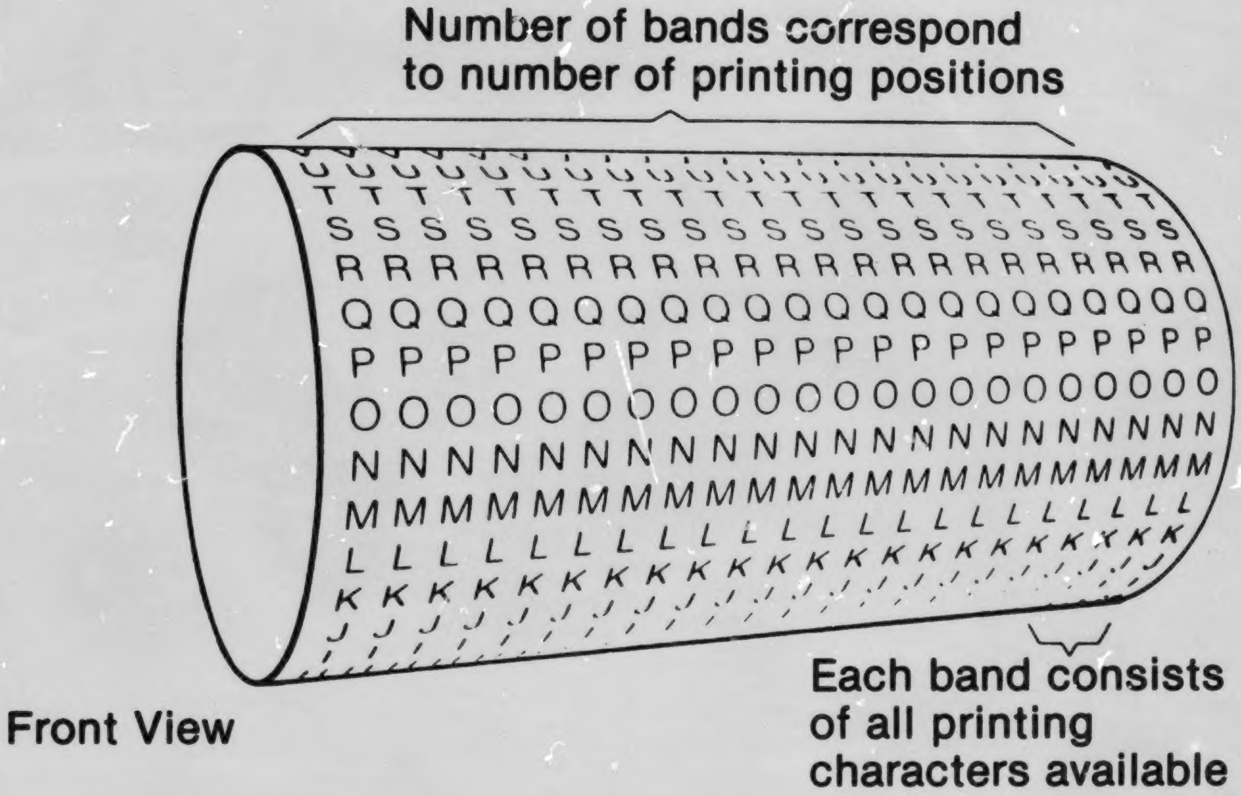
Page-At-A-Time

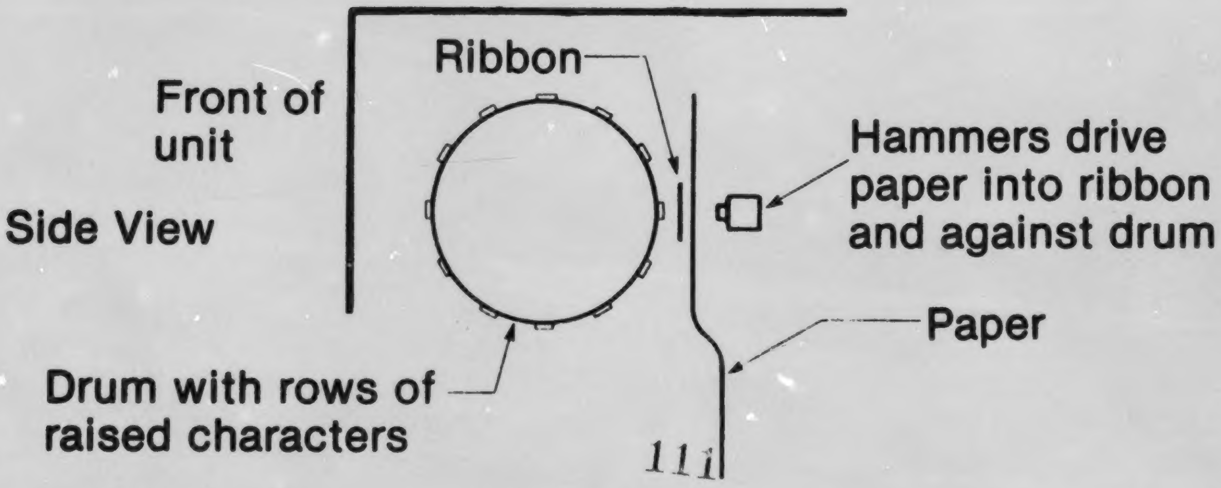
Continuous Forms

Cut Forms

Hard Copy

A Print Drum


Number of bands correspond to number of printing positions
U
T
S
R
Q
P
O
N
M
L
K
J
Each band consists of all printing characters available
Front View


Ribbon
Front of unit
Side View
Hammers drive paper into ribbon and against drum
Paper
Drum with rows of raised characters

INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

ASSIGNMENT SHEET #1: EQUIPMENT SPEED AND COST

Directions: Complete the following exercises.

A. A card reader inputs cards at the rate of 2,000 cards per minute and each card has 80 characters per card. Calculate the number of characters read by the card reader each second.

B. A magnetic tape drive reads the tape at 200 inches per second. Characters are recorded on tape at a density of 1600 characters per inch. Calculate the data transfer rate in characters per second (CPS) using the formula: Density x Speed = Data Transfer Rate.

C. Assume that your computer system uses magnetic tape with a density of 1600 Bytes Per Inch (BPI), an Interrecord Gap (IRG) of 1/2 inch, and a record length of 100 bytes. Calculate the relationship of IRG space used on the tape compared to the records space using the formula: $\frac{\text{BPI x IRG}}{\text{Bytes Per Second}}$

D. Assume the same information as in C above except that 100 records are blocked (blocking factor) and that the Interblock Gap (IBG) is 1/2 inch. Calculate the relationship of IBG space used on the tape compared to the records space using the formula:

$$\frac{\text{BPI x IBG}}{\text{Blocking Factor x Bytes Per Record}}$$

112

E. 1. Assume that a moving-head magnetic disk drive has a seek time of 27 milliseconds and a rotational delay of 8.3 milliseconds. If access time equals seek time plus rotational delay, how long does it take to access a record from this magnetic disk drive?

2. Assume that a fixed-head magnetic disk drive has a rotational delay of 5.0 milliseconds. Using the formula from E.1., above, how long does it take to access a record from this magnetic disk drive?

INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

ASSIGNMENT SHEET #2: DECODING AND PARITY

Directions: Complete the following exercises.

A. Using the Hollerith code, interpret the holes punched in an 80-column card. Each individual column contains holes punched in the following rows:

Column 1 - Rows 12 and 3
Column 2 - Rows 11 and 6
Column 3 - Rows 0 and 3
Column 4 - Row 6
Column 5 - Rows 11, 3, and 8
Column 6 - Row 12
Column 7 - Row 0 or 10

B. One of your coworkers is interpreting the punched holes in a 96-column card using the Binary Coded Decimal (BCD) code. Help your coworker interpret the following columns:

Column 1 - Holes in rows B, A, and 2
Column 2 - Holes in rows B and 1
Column 3 - Holes in rows A and 2
Column 4 - Hole in row A
Column 5 - Hole in row 2
Column 6 - Holes in rows 1, 2, and 4
Column 7 - Holes in rows 1 and 8

C. The media used by a computer system utilizes parity checking for accuracy. On the media given below, indicate which of the frames would require a parity bit to be turned on if parity is odd.

Columns	1	2	3	4	5	6	7
Parity							
Row 1						•	
Row 2	•		•			•	•
Row 3	•	•			•	•	
Row 4				•		•	
Row 5	•	•			•	•	•
Row 6		•	•		•	•	
Row 7	•			•		•	•

INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

ASSIGNMENT SHEET #3: DATA PROCESSING DOCUMENTS

Directions: Complete the following exercises.

Several of the items of media presented in the outline are used for billing purposes. A portion of each item is to be returned when the bill is paid and the other portion is for the records of the person paying the bill. The portion to be returned is often read by special equipment to update the company records. With permission from the person receiving the bill, bring four (4) of these items with you to class. Be prepared to explain the use of each item and interpret as much of the information as you can. Compose a courteous letter to the company which sent the bill and ask how the returned portion is used in their data processing operations. Be prepared to discuss the company methods with the class.

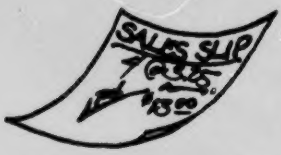
INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

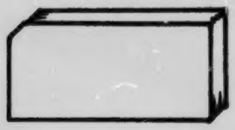
ASSIGNMENT SHEET #4: DATA PROCESSING COMPONENTS

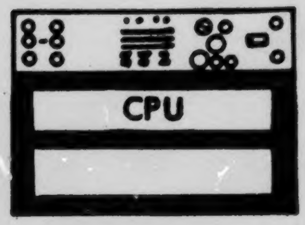
Directions: Using the terms at the left, label the diagrams below with the names of the components of a data processing system.

Data Processing Components

Input
Output
Processing
Source Document
Storage

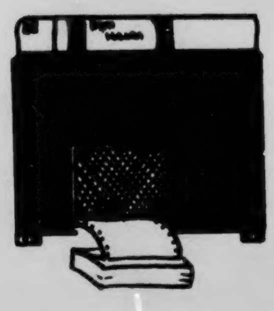


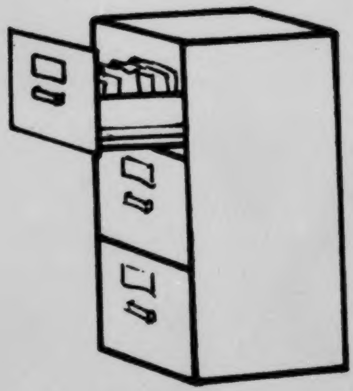




______________ ______________ ______________

______________ ______________





INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

ASSIGNMENT SHEET #5: ADVANTAGES AND DISADVANTAGES OF INPUT/OUTPUT MEDIA

Directions: Listed in Column II are commonly-used types of input/output media. Listed in Column I are statements of advantages and disadvantages of input/output media. For each statement in Column I, write the corresponding letter of the type of media to which the statement refers. (Some statements refer to more than one type of media).

COLUMN I
Advantages/Disadvantages

___ 1. Can be read by anyone

___ 2. Requires a great amount of storage space

___ 3. Slow input

___ 4. Requires backput in case of damage

___ 5. Cannot be accidentally erased

___ 6. Data are invisible - cannot be read visually.

___ 7. Data can be accidentally erased.

___ 8. Allows random access

___ 9. Records can be processed as they occur.

___10. Used mainly with minicomputers and microcomputers

___11. Contains only one record

___12. Can be reused

___13. Cannot be reused

___14. Allows only sequential access

COLUMN II
Media

a. Diskette

b. Magnetic disk

c. Magnetic tapes

d. Punched cards

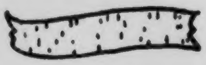
e. Punched tape

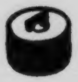
INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

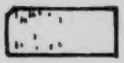
ASSIGNMENT SHEET #6: RECOGNIZING COMMON INPUT/OUTPUT MEDIA AND DEVICES

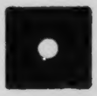
Directions: Select the name of each item in Column I from the list in Column II. Write the corresponding letter on the line in the answers column.

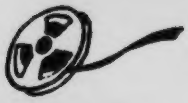
Answers COLUMN I

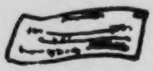
_______________ 1. 

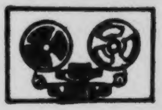
_______________ 2. 

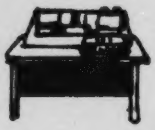
_______________ 3. 

_______________ 4. 

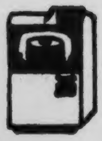
_______________ 5. 

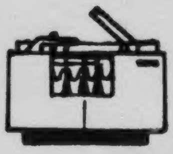
_______________ 6. 

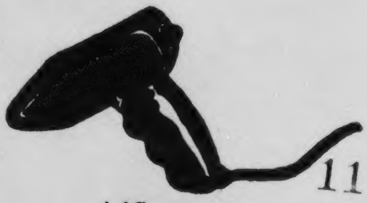
_______________ 7. 

_______________ 8. 

_______________ 9.

_______________ 10. 

_______________ 11. 

_______________ 12. 

COLUMN II

Media

a. Magnetic tape
b. Diskette
c. Magnetic disk
d. Punched tape
e. Punched cards
f. MICR

Devices

g. Keyboard
h. Optical scanner
i. Card punch machine
j. Magnetic tape drive
k. Card read/punch
l. Magnetic disk drive

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INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET #1

A. $\frac{\text{2000 cards per minute}}{\text{60 seconds per minute}} \times$ 80 characters per card = 2,667 characters per second

B. 1600 x 200 = 320,000

C. $\frac{1600 \times .5}{100} = 8$ Thus space used for IRG would be 8 times greater than the space used for record storage

D. $\frac{1600 \times .5}{100 \times 100} = .08$ Thus space used for IBG would be 8% or approximately 1/12 of the space used for record storage

E. 1. 35.3 milliseconds (27 milliseconds + 8.3 milliseconds)
   2. 5.0 milliseconds (No seek time with fixed-head magnetic disk drives)

ASSIGNMENT SHEET #2

A. Column 1 - Letter C
Column 2 - Letter O
Column 3 - Letter T
Column 4 - Number 6
Column 5 - Symbol $
Column 6 - Symbol &
Column 7 - Number 0

B. Column 1 - Letter B
Column 2 - Letter J
Column 3 - Number 5
Column 4 - Number 0
Column 5 - Number 2
Column 6 - Number 7
Column 7 - Number 9

C. Column 1 - On
Column 2 - Off
Column 3 - On
Column 4 - On
Column 5 - Off
Column 6 - Off
Column 7 - Off

ASSIGNMENT SHEET #3

Answers will vary with the student.

ASSIGNMENT SHEET #4

Source document, input, processing, output, and storage

ASSIGNMENT SHEET #5

1. d
2. d, e
3. d, e
4. a, b, c
5. d, e
6. a, b, c
7. a, b, c
8. a, b
9. a, b
10. a
11. d
12. a, b, c
13. d, e
14. c, d, e

ASSIGNMENT SHEET #6

1. d
2. c
3. e
4. b
5. a
6. f
7. j
8. i
9. g
10. l
11. k
12. h

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INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

EXAMINATION

1. Locate the correct answer from Column B to each definition in Column A and record the answer in the blank provided.

Column A

___a. Input device used to process data printed in magnetic ink with specially designed numbers and symbols.

___b. Device that identifies each character by comparing its distinctive features with those stored in computer memory.

___c. Rectangular piece of film on which images have been placed or recorded.

___d. Symbol made up of a series of vertical bars that reflect light from an optical scanner.

___e. Direct method of accessing data regardless of location in the file.

Column B

1. Microfiche
2. MICR
3. Random access
4. UPC
5. OCR
6. Sequential access

2. Define these two terms:

a. Data input -

b. Data output -

3. Briefly describe the function of each of the following punched card machines:

a. Keypunch -

b. Verifier -

c. Sorter -

4. Distinguish in two different ways the Hollerith card and the 96-column card.

Hollerith Card	96-column Card
a.	a.
b.	b.

5. List two advantages and two disadvantages of processing data using each of the following media:

Punched Card

a. Advantages

b. Disadvantages

Magnetic Tape

a. Advantages

b. Disadvantages

6. Why is the floppy disk so popular with smaller processing systems?

7. Why was magnetic ink character recognition developed?

8. Match the optical reader from Column B with the media it reads in Column A.

Column A	Column B
___a. Reads pencil marks	1. Optical bar reader
___b. Reads Universal Product Code	2. Optical character reader
___c. Reads characters in special type font	3. Optical mark reader

9. Indicate the purpose of each of the three types of keyboard machines listed below:

a. Computer console -

b. Remote terminal -

c. Key-to-disk -

10. The distinguishing characteristic of the three types of printers listed below is speed. Indicate how each of the types of printers does its printing or appears to do its printing. Also, indicate whether the printer is impact or nonimpact.

   a. Character printer -

   b. Line printer -

   c. Page printer -

11. List three different media which can be used for either input or output.

   a.

   b.

   c.

12. Explain why more time is required to read an entire file randomly than to read a file containing the same information sequentially.

13. Indicate by placing numbers in the blank at the left of each input and output device its relative speed compared to other devices listed. Assume 1 to be the fastest and 3 to be the slowest.

Input	Output
___a. Magnetic disk drive	___a. Magnetic tape reader
___b. Card reader	___b. Magnetic disk drive
___c. Magnetic tape reader	___c. Card punch

INPUT/OUTPUT DEVICES AND MEDIA
UNIT II

ANSWERS TO EXAMINATION

1. a. 2

   b. 5

   c. 1

   d. 4

   e. 3

2. Data input - the process of transferring machine readable data into the computer system for processing or storage.

   Data output - the process of producing information and data in a form that is readable and usable by humans or computer input devices.

3. Keypunch - punches holes in cards to be read by a card reader.

   Verifier - checks accuracy of keypunching operations.

   Sorter - arranges punched cards according to a predetermined plan.

4.

Hollerith Card	96-column card
80 columns	96 columns
Larger than 96-column card	Smaller than Hollerith card
12 rows for data	3 tiers with 6 rows each
Rectangular holes	Round holes
Hollerith code	Binary Coded Decimal Code

5. Punched cards

   Advantages - Printed data can be read by anyone; data cannot be accidentally erased; equipment is inexpensive; cards provide a permanent record; cards can serve as business documents; each record is a unit.

   Disadvantages - Cards are not reusable for different data; cards require a card reader which is slow; cards require considerable storage space; cards have a fixed length, 80 or 96 columns; cards can be damaged or lost, destroying data; cards require people to handle them.

   Magnetic Tape

   Advantages - Faster entry than cards; record length not limited by media; material can be revised easier than cards; entry machines are quieter than keypunch; fewer steps decrease error possibilities; tape is more durable than cards; tape can be reused for different data.

Disadvantages - Devices more expensive than card devices; more difficult to organize than cards; requires a backup tape in case tape is damaged; stored material retrieved by sequential access; stored data can only be read by machine; data can be accidentally erased; tape reels require special storage facilities.

6. Provides faster load speeds than tape, yet is less expensive than larger magnetic disks.

7. To assist banks with processing checks

8. a. 3

   b. 1

   c. 2

9. a. Communicates in computer room with the computer

   b. Communicates with the computer from a location other than the computer room

   c. Records data on magnetic disk for data input

10. a. Prints a character at a time - impact

    b. Appears to print a line at a time - impact

    c. Prints an entire page at a time - nonimpact

11. a. Punched cards

    b. Punched paper tape

    c. Magnetic tape including cassettes and cartridges

    d. Magnetic disk including floppies and flippies

    e. Printing and display media on keyboard terminals

12. When reading sequentially, the file is read from beginning to end. When reading randomly, a transfer is required to each new data item, requiring more reading time.

13.

Input	Output
a. 1	a. 2
b. 3	b. 1
c. 2	c. 3

DATA ENTRY AND MANUAL ACCOUNTING
UNIT III

UNIT OBJECTIVE

After studying this unit, students should be able to follow data entry procedures and complete elementary manual accounting processes.

SPECIFIC OBJECTIVES

After studying this unit, students should be able to:

1. Match terminology with definitions.
2. List examples of source documents.
3. Differentiate between internal and external information generators.
4. Follow the accounting cycle to complete a set of books accurately.
5. Recognize data entry devices.
6. Discuss the important characteristics of data entry.
7. Compare the two types of data fields.
8. Name the two types of data records.
9. Identify factors to consider when planning for data entry.

DATA ENTRY AND MANUAL ACCOUNTING
UNIT III

SUGGESTED ACTIVITIES

I. Instructor

   A. Make transparencies.

   B. Provide students with objectives and discuss.

   C. Provide students with information and assignment sheets and discuss.

   D. Give examination

II. Student

   A. Read objectives.

   B. Study information sheets as presented and assigned by instructor.

   C. Complete assignment sheets.

   D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit Content

   A. Objectives

   B. Notes to the instructor

   C. Information sheets

   D. Transparency masters

      1. TM-III-1: Data Entry

      2. TM-III-2: Data Entry and Input

      3. TM-III-3: The Accounting Equation

      4. TM-III-4: Income Statement

      5. TM-III-5: Capital Statement

      6. TM-III-6: Balance Sheet

7. TM-III-7: Effects of Debit and Credit
8. TM-III-8: Posting
9. TM-III-9: The Keypunch Keyboard
10. TM-III-10: Data Entry Methods
11. TM-III-11: Multistation Data Entry
12. TM-III-12: Steps to Help Insure Accuracy

E. Assignment sheets

1. AS-III-1: Analyzing Business Transactions
2. AS-III-2: Preparing a Trial Balance

F. Answers to assignment sheets

G. Examination

H. Answers to examination

II. References

A. Some sources to help you teach the transfer of information from manual accounting to automated accounting are:

1. Allen, Warren W., and Klooster, Dale H. Automated Accounting for the Microcomputer. Cincinnati: South-Western Publishing Co., 1982.
2. Hamilton. Accounting Applications for the Microcomputer. New York: McGraw-Hill Publishing Co., 1982.
3. Hamilton. Microcomputer Applications for Accounting: Systems and Procedures. 4th ed., New York: Gregg/McGraw-Hill Publishing Co., 1982.

B. One of your objectives in data entry should be to build a salable skill. Some sources of material for teaching data entry and building skill are:

1. Bux, William E. Keypunch Training Course. 3rd ed., Cincinnati: South-Western Publishing Co., 1975.
2. Bux, William E., and Clark, James F. Data Entry Activities for the Microcomputer. Cincinnati: South-Western Publishing Co., 1982.

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3. Buzby, Beth Moorer. *Data Entry: Concepts and Applications*. Palo Alto, CA: Science Research Associates, Inc., 1982.

4. Carter, Gerald L. *Data Entry Skills, Additional Problems*. Arcata, CA: Apollo Computer Systems, Inc., 1978.

5. Carter, Gerald L., and Minkema, Douglas D. *Data Entry Skills, Key Disk Machine*. 3rd ed., Arcata, CA: Apollo Computer Systems, Inc., 1977.

6. Hanson, R. N., and Rigby, D. S. *Gregg Keyboarding for Information Processing*. New York: Gregg/McGraw-Hill Publishing Co., 1982.

7. *Keypunch Projects*. H. M. Rowe Co., 1971.

8. LaBarre, James. *Keyboarding for Information Processors*, Palo Alto, CA: Science Research Associates, Inc., 1982.

9. Lee, Iva Helen. *Data Entry: Concepts and Exercises*. New York: John Wiley & Sons, Inc., 1982.

10. Macksoud, Donald J. *Typing Speed Development*. Upper Saddle River, NJ: Reinforcement Learning, Inc., 1977.

DATA ENTRY AND MANUAL ACCOUNTING
UNIT III

NOTES TO THE INSTRUCTOR

Should your students need more practice in manual accounting than is presented, use a high school accounting text or college accounting text for additional problems and exercises. It would be most helpful for the students to have the workbook (supplementary papers) to accompany the textbook also. Refer to the preceding page for a list of sources.

Transparency 6: Again, emphasize the importance of accuracy in inputting data to have accurate, usable output. Remember, GIGO!

Upon completion of this Data Entry and Manual Accounting unit, your students should have built a skill on a data entry device and should be able to:

1. Power on and off a data entry device.
2. Identify causes of machine malfunctions and correct, if possible.
3. Execute standard operator service functions, such as changing ribbon, cleaning screens and heads, and emptying card or paper chips.
4. Perform record format operations, such as skipping, duplicating, shifting, zero fill, and justification.
5. Load input media to prepare to key data.
6. Use the keyboard touch system to enter data.
7. Verify visually and/or by machine the accuracy of data entered.
8. Duplicate data to a blank media for the same device.
9. Add to, delete from, or change the data in an existing record.
10. Create a log of work completed.
11. Properly store the completed media for filing or future use.

DATA ENTRY AND MANUAL ACCOUNTING
UNIT III

INFORMATION OUTLINE

I. Terms and Definitions

   A. Account - a record which summarizes changes resulting from business transactions

   B. Accrued expense - an expense incurred but not yet paid

   C. Adjusting entries - journal entries made at the end of an accounting period to bring general ledger accounts up to date

   D. Assets - items of value owned by a business or an individual

   E. Balance sheet - a business report showing the assets, liabilities, and capital on a specific date

   F. Book value - the difference between cost and accumulated depreciation of a plant asset

   G. Capital - the equity of the owner of a business

   H. Capital statement - a statement showing a summary of changes in capital over a specified period of time to yield a current capital balance

   I. Chart of accounts - a list of the accounts with numbers for a business

   J. Closing entries - journal entries which close all revenue and expense accounts

   K. Credit - an amount entered on the right side of an account

   L. Data entry - the recording of human readable data into a form that an input device can interpret for the computer system (Refer to TM-III-1 and TM-III-2.)

   M. Data entry operator - the person who records human readable data from a source document into a form that is machine understandable

   N. Data field - one or more related characters representing a specific data element, such as name, quantity, or dollar amount

O. Data record - a group of related data fields, such as all data pertaining to one employee

P. Debit - an amount entered on the left side of an account

Q. Depreciation - a decline in value of an asset which accumulates over the life of the asset

R. Financial statements - the income statement, capital statement, and balance sheets of a business

S. Income statement - a statement which shows a summary of revenue and expenses to determine net income for a specified period of time

T. Journal - a book in which each business transaction is originally entered

U. Journalizing - the process of recording transactions in a journal

V. Ledger - all of the accounts of a business

W. Liabilities - amounts owed by a business or individual

X. Minus asset (contra asset) - an asset account which has an abnormal credit balance but is closely related to an asset with a normal balance

Y. Mixed accounts - accounts containing an amount which is partly expense and partly asset

Z. Net income - the amount by which revenues exceed expenses

AA. Net loss - the amount by which expenses exceed revenues

BB. Permanent accounts - accounts which are not closed, i.e., asset, liability, and capital accounts

CC. Plant assets - assets with a long life

DD. Post-closing trial balance - a report that verifies the equality of debits and credits after closing all temporary accounts

EE. Posting - the orderly transfer of data from a journal to a ledger

FF. Prepaid expenses - items which are current assets at time of purchase but that will be consumed in operation of business

GG. Source document - document from which raw or original data is obtained

HH. Temporary accounts - accounts which are closed at the end of an operating period, i.e., revenue, expense, income summary, and owner's drawing accounts

II. Trial balance - a report that verifies the equality of the debits and the credits in the ledger

JJ. Work sheet - a form which provides for the sorting and interpreting of the trial balance

II. Examples of Source Documents

A. Completed job or loan applications

B. Returned questionnaires

C. Lists of information

D. Purchase requisitions - notices for ordering items

E. Purchase orders - requests to buy items

F. Receiving reports - records of receipt of items

G. Inventory transfers - items moved from one location to another

H. Materials requisitions - notices for ordering raw materials

I. Sales invoices - forms prepared when a sale is made

J. Sales notices - notices to other departments of a sale

K. Shipping orders - notices to ship items which have been sold

L. Shipping notices - notices that items have been shipped

M. Employee time tickets - forms showing time worked by employees

N. Customer invoices - notices to customers of amounts due for purchases

O. Customer payment notices - accounts receivable collected

P. Vendor notices - notices of amount to pay for purchases

Q. Vendor check - payment for purchases from vendors

III. Examples of Where Information Originates

A. Internal

1. Purchasing department
2. Receiving department
3. Warehouse
4. Production department
5. Sales department
6. Shipping department
7. Customer billing
8. Customer collections
9. Vendor payments

B. External

1. Federal, state, and local government
2. Business owners
3. Vendors
4. Advertising
5. Lenders
6. Customers
7. Labor unions

IV. Manual Accounting

A. Business transaction - the occurrence of an event or condition that results in a change in the assets, the liabilities, or the proprietorship of a business

1. External - transactions affecting more than one business, including our firm
2. Internal - transactions not directly related to other businesses

B. Accounting equation (Refer to TM-III-3.)

1. Assets = Liabilities + Capital
2. Assets - items of value owned by a business

3. Liabilities - amounts owed by a business

4. Capital

   a. The equity of a business attributed to the owner

   b. Assets minus liabilities equal owner's capital

C. Accounting statements

1. Income statement (Refer to TM-III-4.)

   a. Summarizes revenue and expenses

   b. Covers a specific period of time

   c. Determines net income or net loss of a business

2. Capital statement (Refer to TM-III-5.)

   a. Summarizes changes in capital including net income

   b. Covers a specific period of time

   c. Shows a current capital amount

3. Balance sheet (Refer to TM-III-6.)

   a. Lists assets, liabilities, and capital

   b. Prepared as of a specific date, usually the last day of the period covered by the income statement

   c. Two forms of balance sheet

      1) Report form - lists assets, followed by liabilities, then capital
      2) Account form - assets listed on left side; liabilities followed by capital listed on right side

   d. Balance sheet proves accounting equation - Assets = Liabilities + Capital

4. All statements have a heading

   a. Name of business

   b. Title of statement

   c. Date or period of time covered

5. Indentions, captions, dollar signs, and rulings improve readability

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D. Account - a record which summarizes changes resulting from business transactions

1. Ledger - all of the accounts of a specific business enterprise

2. Chart of accounts

    a. Lists the accounts needed by a business

    b. Nature and volume of business transactions determine number of accounts listed.

    c. Assigns each account an account number

        1) Balance sheet accounts
            a) Asset account numbers usually have a "1" as the first digit.
            b) Liability account numbers usually have a "2" as the first digit.
            c) Capital account numbers usually have a "3" as the first digit.
        2) Income statement accounts
            a) Revenue account numbers usually have a "4" as the first digit.
            b) Expense account numbers usually have a "5" as the first digit.

    d. An example of a possible chart of accounts

ASSETS	
Cash	11
Accounts receivable	12
Supplies	14
Prepaid rent	15
Equipment	18
Accumulated depreciation-equipment	19
LIABILITIES	
Accounts payable	21
Salaries payable	22
CAPITAL	
Alex Waters, Capital	31
Alex Waters, Drawing	32
Income Summary	33
REVENUE	
Sales	41
EXPENSES	
Salary expense	51
Supplies expense	52
Rent expense	53
Depreciation expense	54
Miscellaneous expense	59

3. An account has several parts.

    a. The title

    b. The account number from the chart of accounts

    c. A left side (debit side)

        1) A date column
        2) An items column
        3) A posting reference column
        4) A debit amount column

    d. A right side (credit side)

        1) A date column
        2) An items column
        3) A posting reference column
        4) A credit amount column

E. Analysis of journal entries (Refer to TM-III-7.)

1. A journal entry consists of one or more accounts debited and one or more accounts credited.

2. Each debit to an account signifies one fact.

    a. An increase to an asset account

    b. A decrease to a liability account

    c. A decrease to a capital account

    d. A decrease to a revenue account

    e. An increase to an expense account

3. Each credit to an account signifies one fact.

    a. A decrease to an asset account

    b. An increase to a liability account

    c. An increase to a capital account

    d. An increase to a revenue account

    e. A decrease to an expense account

F. Journalizing - the process of recording analyzed transactions in a book of original entry called a journal (Refer to TM-III-8.)

1. Year, month, and day of the month are recorded in the date column.

2. The title of the account(s) debited is written at the extreme left of description column.
3. The amount debited is recorded in the debit amount column.
4. Other accounts debited, if any, are recorded immediately below previous accounts debited.
5. The title of the account(s) credited is written, indented about one-half inch, on the next line below last account debited in description column.
6. The amount credited is recorded in credit amount column.
7. Other accounts credited, if any, are recorded immediately below previous accounts credited.
8. A brief description of the transaction may be written below the last account credited and indented about one-half inch additional in the description column.
9. The title of accounts used in entries must appear in the chart of accounts or the chart of accounts must be revised to include the new title.
10. The posting reference column is not used in journalizing.

G. Posting from the journal to the ledger accounts

1. Locate the account title in the ledger which agrees with the journal entry. (Begin with the first line of the journal entry and proceed through each part.)
2. The date of the journal entry is recorded in date column of the ledger account.
3. The amount debited or credited is recorded on the correct side of the account.
4. The journal page of the entry is recorded in the posting reference column of the ledger account.
5. The ledger account number is recorded in the posting reference column of the journal entry.
6. Proceed as above (1 through 5) - through each debit and credit part of each journal entry to be posted.

H. Preparing a trial balance

1. Prepared as of last day of the accounting period

2. Verifies the equality of debits and credits in the ledger

3. Shows account titles of ledger accounts used during accounting period

4. Presents the balance, if any, of each account in the ledger

   a. Add amounts in debit column of the account.

   b. Add amounts in credit column of the account.

   c. Find the balance (difference between) debits and credits in each account.

   d. Record the balance in the debit or credit column of the trial balance.

I. Adjusting entries - entries made at the end of an accounting period (fiscal period) to correct mixed account balances and to enter other financial data not recognized currently but necessary to bring the books up to date.

1. Mixed accounts

   a. Part of the amount has been used (expense).

   b. Part of the amount has not been used (asset).

   c. Prepaid expenses - The amount that is paid is then used, such as insurance.

      1) Determine the amount used.
      2) Debit an appropriate expense account and credit an appropriate asset account for the amount used.

2. Plant assets - assets owned by the business, usually of a long-life nature

   a. Record decline in value (depreciation) to adjust.

   b. Use a contra asset (minus asset) account.

   c. Debit a depreciation expense account and credit the accompanying contra asset account for the amount of the decline in value.

   d. Book value - the difference between cost and the accumulated depreciation of a plant asset

    3. Accrued expenses (liabilities)
        a. Accrual - expense that has accrued and is paid periodically, such as salaries to employees
        b. Determine the amount accrued.
        c. Debit an appropriate expense account and credit an appropriate liability account.

J. Complete the work sheet.
    1. Record the trial balance in the proper columns if not prepared on worksheet.
    2. Record adjusting entries in proper columns of worksheet (columns 3 and 4).
    3. Combine the amounts in the trial balance and adjustment columns to yield a balance.
    4. Extend the balance to either the income statement columns or the balance sheet columns. (If the balance is a debit, extend as a debit; if a credit, extend as a credit.)
    5. Total all columns.
    6. Prove debits equal credits.
        a. Calculate the difference between the income statement debit column total (expenses) and the income statement credit column total (revenue).
        b. Add this difference (if a net income) to the income statement debit column.
        c. Add this difference (if a net income) to the total of the balance sheet credit column. (If a loss occurred, the difference will be added to the balance sheet debit total and the income statement credit total.)
        d. Income statement debit and credit should be equal.
        e. Balance sheet debit and credit should be equal.

K. Prepare the financial statements from the worksheet.
    1. Income statement first
    2. Then capital statement

3. Finally the balance sheet

L. Journalize and post the adjusting entries as recorded on the worksheet.

M. Journalize and post the closing entries.

   1. Close balances of all temporary accounts (revenue and expenses) into the income summary accounts.

   2. Close the balance of the income summary account into the capital account.

   3. Close the balance of the drawing account into the capital account.

N. Prepare the post-closing trial balance.

   1. Obtain balances from the ledger accounts which have not been closed (assets, liabilities, and the owner's capital).

   2. Final check to prove that debits equal credits.

O. The accounting cycle

   1. The business transaction occurs.

   2. The business document is prepared.

   3. The transaction is analyzed.

   4. The transaction as analyzed is recorded in the journal.

   5. The journal entry is posted to the appropriate accounts in the ledger.

   6. The trial balance is prepared.

   7. The work sheet is completed.

   8. The accounting statements are prepared.

   9. The adjusting entries are recorded in the journal and posted to the ledger.

   10. The closing entries are recorded in the journal and posted to the ledger.

   11. The post-closing trial balance is prepared.

V. Keyboard Data Entry Devices (Refer to TM-III-9, TM-III-10, and TM-III-11.)

A. Keypunch machine

B. Paper tape punch

C. Key-to-tape

D. Key-to-disk

E. Terminals

  1. Printing

  2. Display

  3. Combination of data entry and data input

F. May have buffer storage area

G. May be a microcomputer

H. Bottleneck to faster response from computer

  1. Slower devices

  2. Limited to keyboarding ability of data entry operator

VI. Most Important Characteristics of Data Entry

A. Speed

  1. Contributes to faster processing

  2. Speed unimportant if data is inaccurate

B. Accuracy (Refer to TM-III-12.)

  1. Validation - checking to insure that transaction forms and documents are correct

  2. Verification - checking data against original document to insure accuracy in entering data

  3. Editing - checking data for form which can be processed by applications programs

    a. Errors cause error report to be generated.

    b. Report used to correct or edit data

    c. Can be used to convert from one data media to another

VII. Data Field

A. Definition - one or more characters representing a specific data element, such as name, quantity, or dollar amount

B. Types

1. Fixed-length field

a. Provides space for largest data anticipated

b. Example of name field - Name field must be at least 17 spaces to accommodate longest name.

1) Carol Spry (10 spaces required)
2) Thomas Pennington (17 spaces required)
3) Mary Penniston (14 spaces required)

c. Simpler to program

d. Requires less CPU time to execute

2. Variable-length field

a. Length of field must be specified.

1) Subfield indicating length of field is placed at beginning of field.
2) Special field terminating symbol is placed at end of field.
3) Special field mark varies with different systems.

VIII. Data Record

A. Definition - group of related data fields, such as data pertaining to one employee

B. Different ways data record can be recorded

1. Fixed length records

a. Reserve enough fields to accommodate all anticipated data.

b. Unused space filled with fill character or left blank

2. Variable-length record - a record having a length independent of the length of other records with which it is logically or physically associated

IX. Plan for Data Entry

A. Layout media

  1. Identify types of data to be entered from source documents.

  2. Determine method of indicating field termination if using variable-length fields and records.

  3. Determine length of data fields or records if fixed-length.

    a. Field may be one or more columns.

    b. Blanks between fields

      1) Computer system can read either way.
      2) Blanks improve human readability.

    c. Relate length of field to desired output.

    Example: If a 30-character field is desired for output, a 30-character field must be used for input. The computer system will not make up characters to complete the desired length of output.

B. Prepare for special features in data entry.

  1. Identify sequence of fields in record.

  2. Identify type of data in field.

    a. Alphabetic - letters

    b. Numeric - numbers

    c. Alphanumeric (Alphameric) - both letters and numbers in same field

  3. Justification of data in fixed-length fields

    a. Alphabetic and alphanumeric data are usually justified on left side of column (field). First letter of each name begins at same position.

    Examples: Sharon Fredd
    Don Marsh
    Francis Lamkin

    b. Numeric data usually are justified on right side of column. Last digit in each number ends at same position.

Examples: 17642
5
550

c. Helps insure processing of correct data

d. Helps insure printout will be in desired format

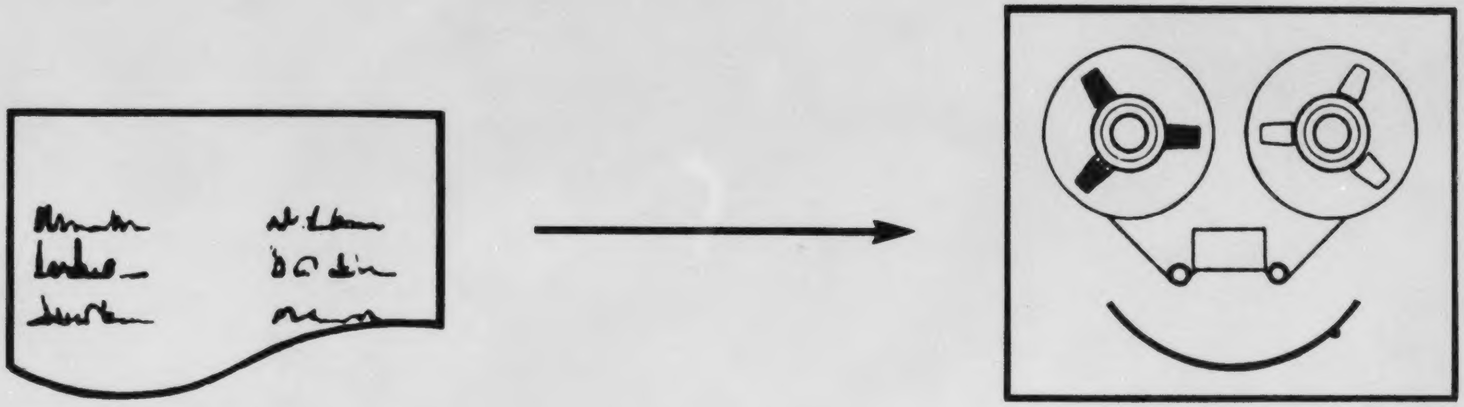
4. Zero fill

a. Unused spaces in fixed length field may be left blank or may be filled with zeroes.

Examples: 17642
00005
00550

b. Does not affect value of number because left zeroes are insignificant

Data Entry

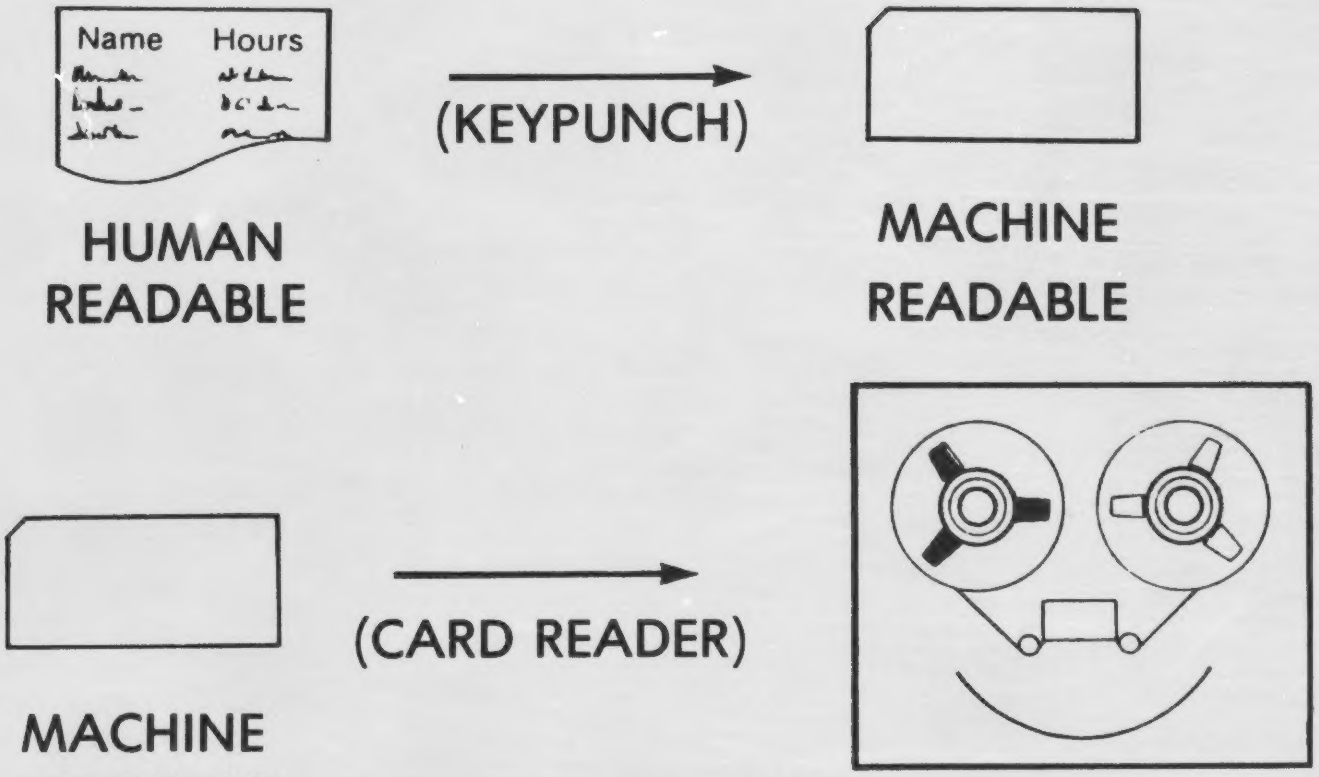


HUMAN UNDERSTANDABLE

COMPUTER UNDERSTANDABLE

TM-III-1

Data Entry and Input



(KEYPUNCH)

HUMAN
READABLE

MACHINE
READABLE

(CARD READER)

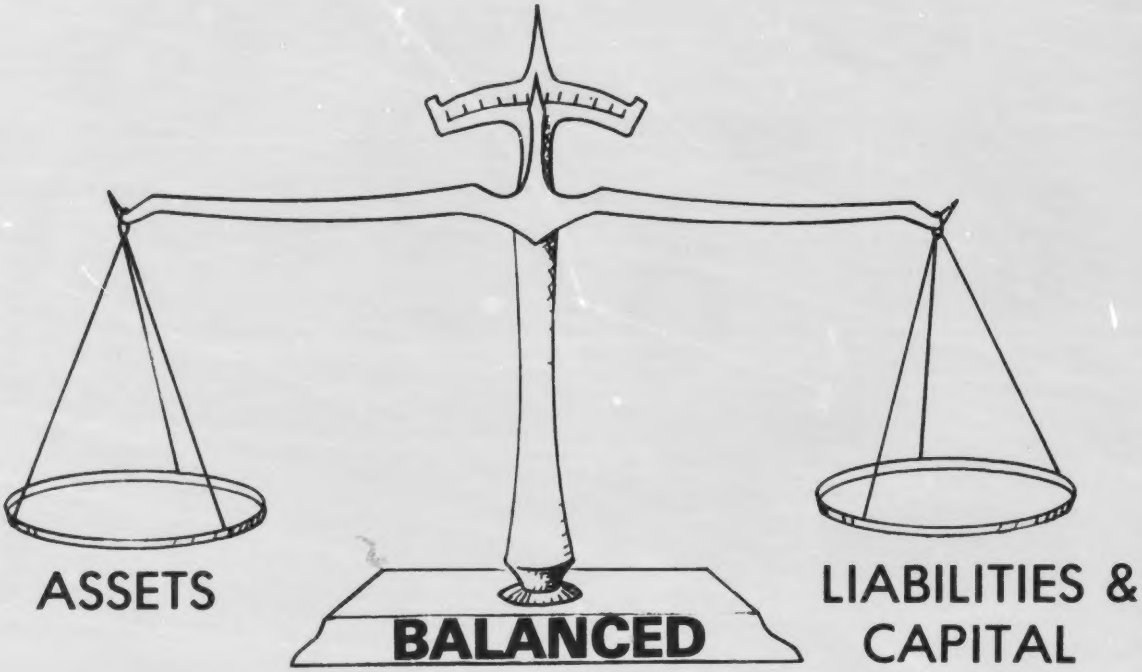
MACHINE
READABLE

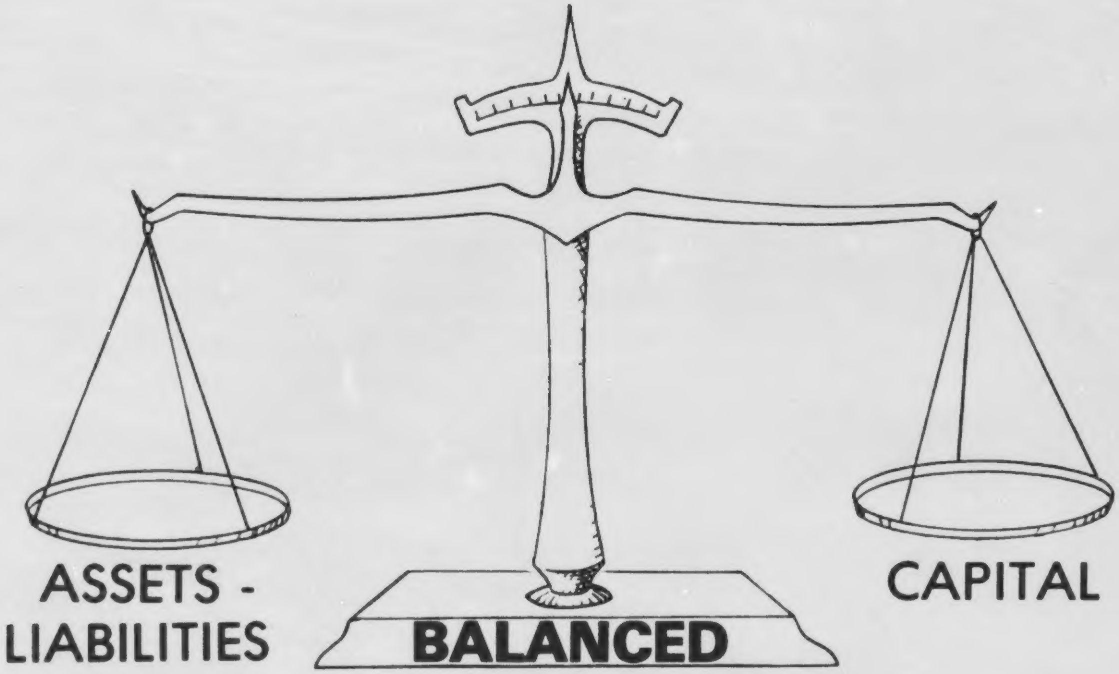
COMPUTER

TM-III-2

TM-III-3

The Accounting Equation


ASSETS
BALANCED
LIABILITIES &
CAPITAL


ASSETS -
LIABILITIES
BALANCED
CAPITAL

TM-III-4

Income Statement

(Company Name)
(Statement Name)
for (Period) Ended (Date)

Revenue:		
Sales		$18,680.00
Expenses:		
Salary expense	$9,128.00	
Rent expense	6,000.00	
Supplies expense	462.50	
Depreciation expense	360.00	
Miscellaneous expenses	118.62	
Total expenses		$16,069.12
Net Income		$2,610.88

TM-III-5

Capital Statement

(Company Name)
(Statement Name)
For (Period) Ended (Date)

Capital, January 1, 198_		$18,164.29
Net income for the year (From the income statement)	$2,610.88	
Less owner's drawing	1,868.19	
Increase in capital		742.69
Capital, December 31, 198_		$18,906.98

TM-III-6

Balance Sheet

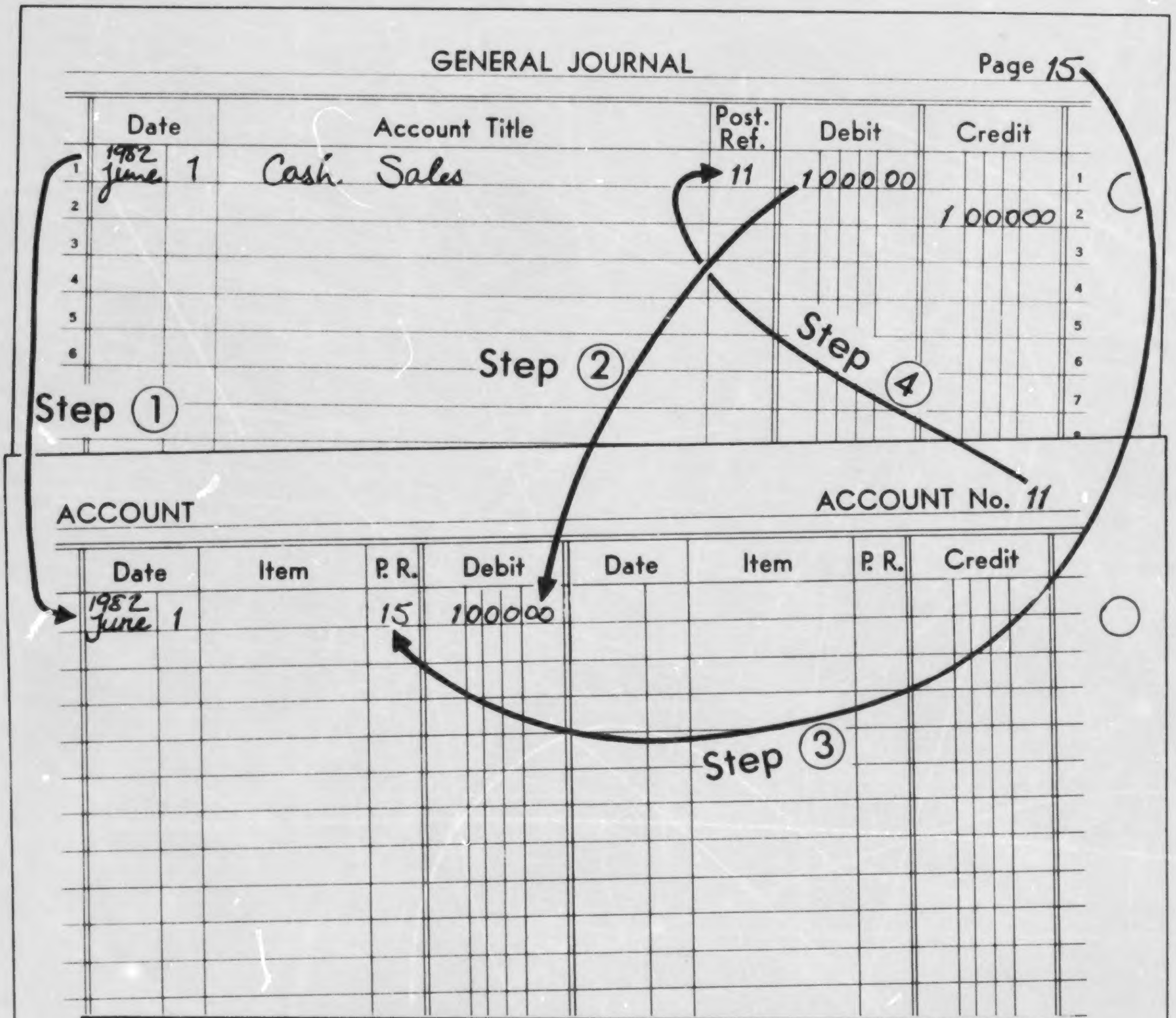
(Company Name)
(Statement Name)
(Specific Date)

Assets		
Current assets:		
Cash	$3,891.67	
Accounts receivable	2,465.31	
Supplies	1,888.40	
Prepaid rent	500.00	
Total current assets		$8,745.38
Plant assets:		
Equipment	$12,098.12	
Less accumulated depreciation	1,226.49	
		10,871.63
Total assets		$19,617.01
Liabilities		
Accounts payable	$510.03	
Salaries payable	200.00	
Total liabilities		$710.03
Capital		
(Owner's name), capital (From the capital statement)		$18,906.98
Total liabilities and capital		$19,617.01

Effects of Debit and Credit

Account Type	Increase Side	Decrease Side	Normal Balance
Asset	Debit	Credit	Debit
Liability	Credit	Debit	Credit
Capital:			
Capital, Capital stock, and Retained earnings	Credit	Debit	Credit
Drawing and Dividends	Debit	Credit	Debit
Revenue	Credit	Debit	Credit
Expense	Debit	Credit	Debit

Posting


GENERAL JOURNAL
Page 15
Date
Account Title
Post. Ref.
Debit
Credit
1982
June 1
Cash
Sales
11
1 000 00
1 000 00
Step ①
Step ②
Step ③
Step ④
ACCOUNT
ACCOUNT No. 11
Date
Item
P. R.
Debit
Date
Item
P. R.
Credit
1982
June 1
15
1000 00

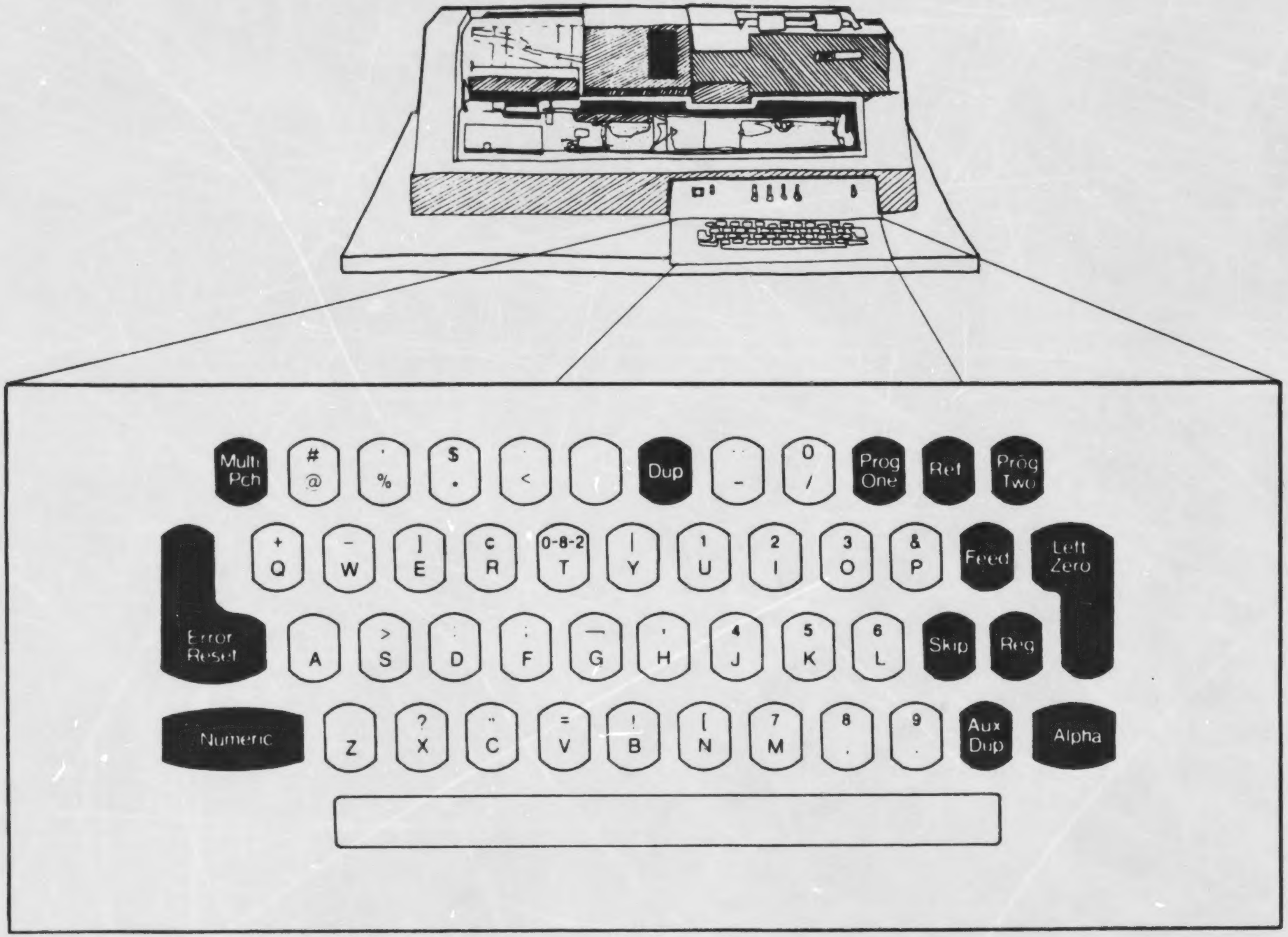
Step 1. Transfer date from journal to ledger.

Step 2. Transfer amount from journal to correct side of ledger.

Step 3. Transfer journal page number to ledger.

Step 4. Transfer account number to journal.

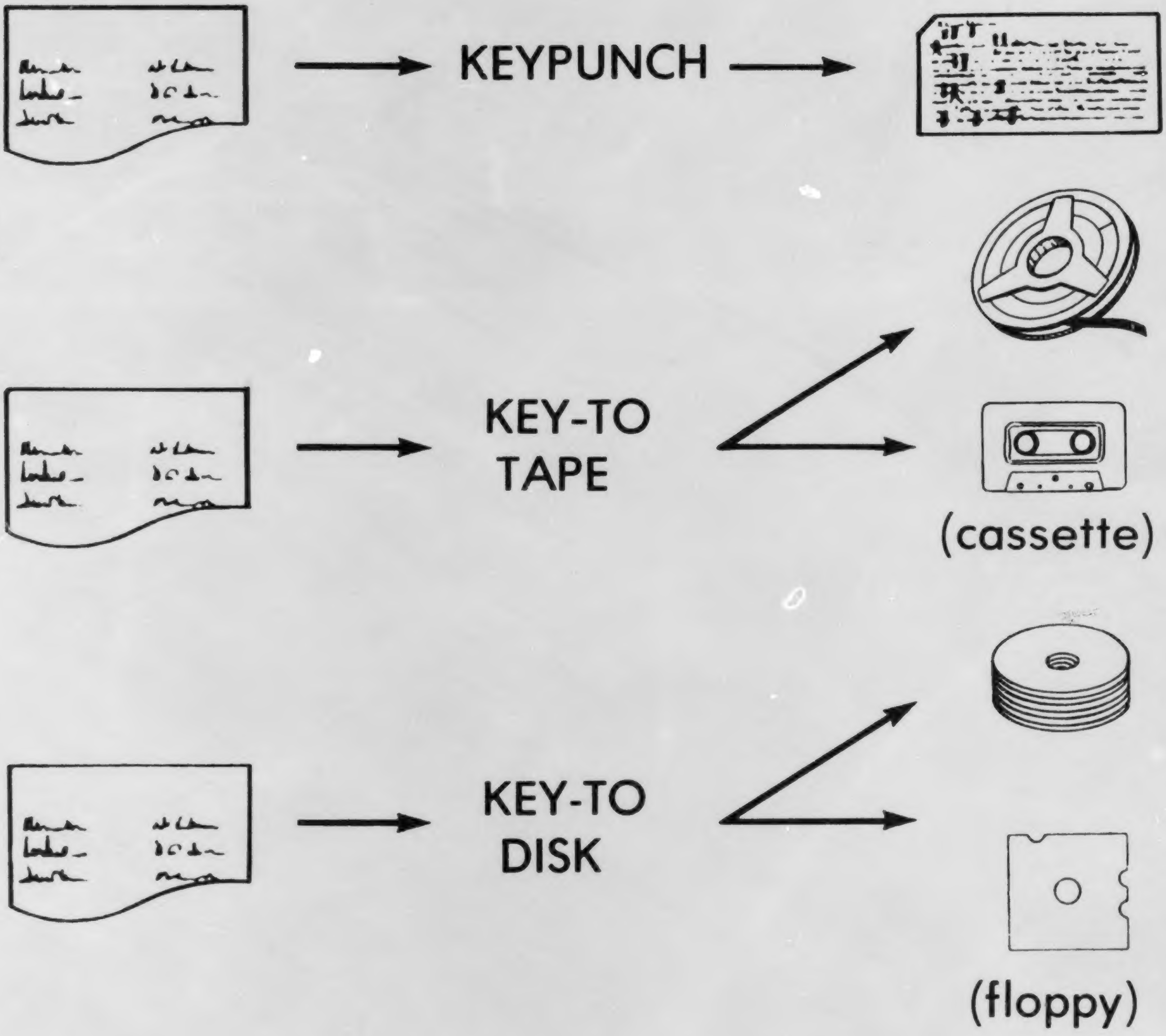
The Keypunch Keyboard


Multi Pch
# @
' %
$.
. <
Dup
.. _
0 /
Prog One
Rel
Prog Two
Error Reset
+ Q
− W
] E
¢ R
0-8-2 T
| Y
1 U
2 I
3 O
& P
Feed
Left Zero
A
> S
: D
; F
— G
' H
4 J
5 K
6 L
Skip
Reg
Numeric
Z
? X
" C
= V
! B
[N
7 M
8 .
9 .
Aux Dup
Alpha

TM-III-9

TM-III-10

Data Entry Methods



KEYPUNCH

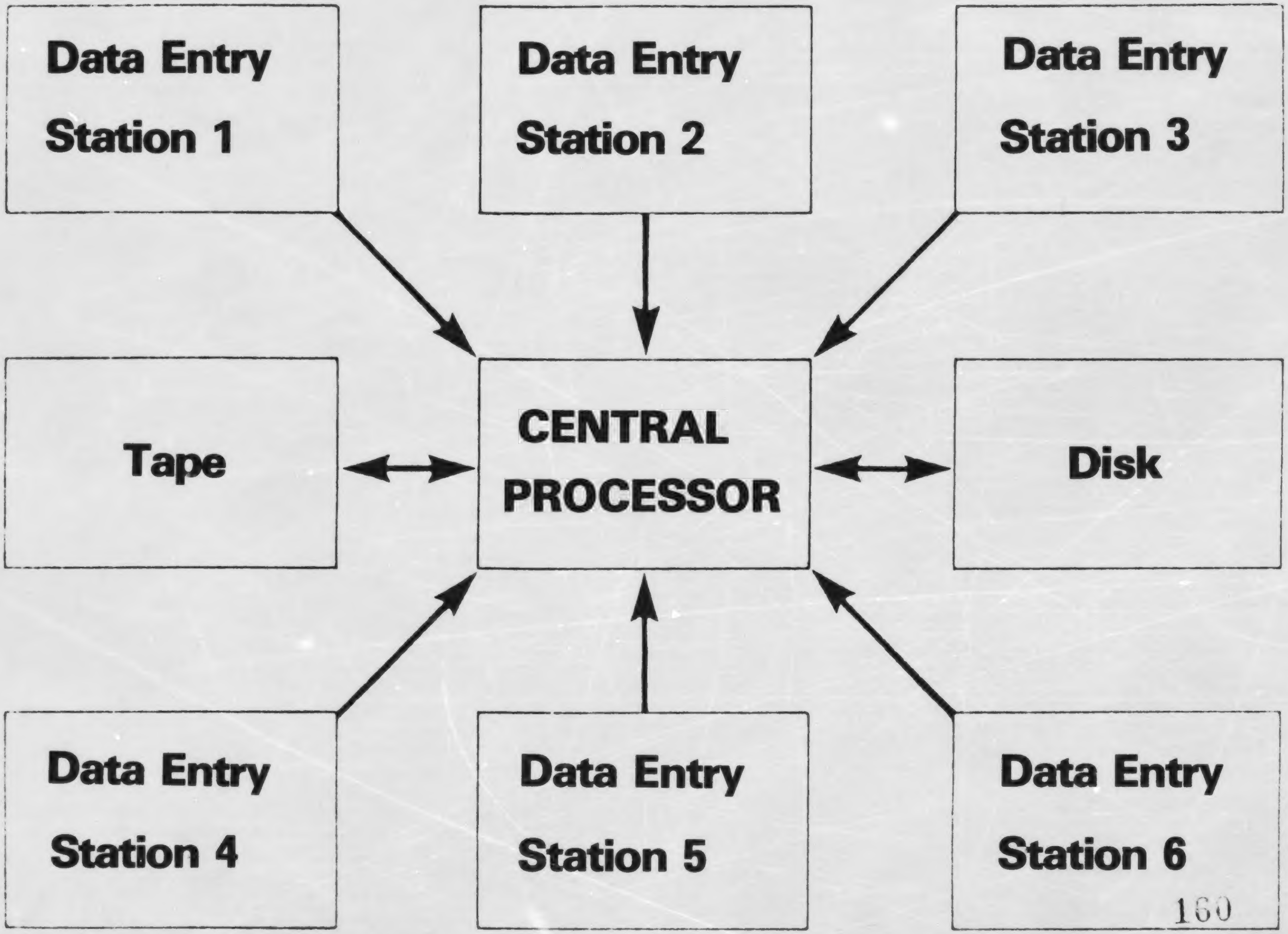
KEY-TO TAPE

(cassette)

KEY-TO DISK

(floppy)

MultiStation Data Entry



Data Entry Station 1

Data Entry Station 2

Data Entry Station 3

Tape

CENTRAL PROCESSOR

Disk

Data Entry Station 4

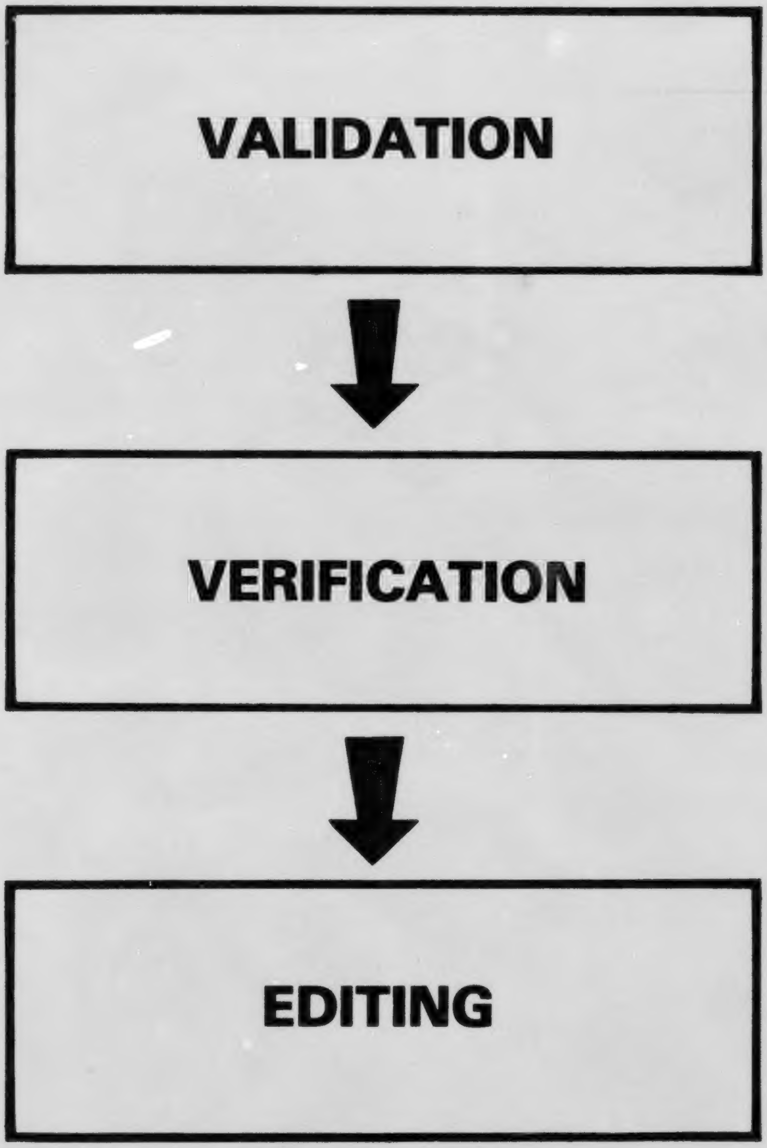
Data Entry Station 5

Data Entry Station 6

TM-III-11

TM-III-12

Steps to Help Insure Accuracy



VALIDATION

VERIFICATION

EDITING

ASSIGNMENT SHEET #1: ANALYZING BUSINESS TRANSACTIONS

Directions: Analyze the following business transactions and state the account title or titles to be debited and the account title or titles to be credited.

1. Hal Wilson deposited $2,100 in a business bank account.
   Debit--

   Credit--

2. Purchased equipment for $1,200 paying $700 cash and the remainder on account.
   Debit--

   Credit--

3. Purchased supplies for $80 cash.
   Debit--

   Credit--

4. Paid rent for the month, $200 cash.
   Debit--

   Credit--

5. Sold merchandise for $2,100 receiving $1,500 cash and $600 to be paid later.
   Debit--

   Credit--

6. Paid $300 on account from purchase of equipment above.
   Debit--

   Credit--

7. Paid salaries of $100 to employee.
   Debit--

   Credit--

8. Withdrew $200 for personal use.
   Debit--

   Credit--

ASSIGNMENT SHEET #2: PREPARING A TRIAL BALANCE

Directions: Prepare a trial balance for the Underwater Weaving Co. as of the current date. List the following accounts in the order in which they would appear in a chart of accounts and record the account balances on the proper side so that the trial balance is in balance. All accounts have normal balances.

a.	Accounts payable	300
b.	Accounts receivable	700
c.	Equipment	5,000
d.	Cash	1,200
e.	Miscellaneous expense	150
f.	Salaries payable	400
g.	Sales	3,000
h.	Capital stock	4,000
i.	Salary expense	1,300
j.	Prepaid insurance	50
k.	Retained earnings	600
l.	Note payable	1,000
m.	Supplies	400
n.	Rent expenses	500

Account Title	Debit	Credit

DATA ENTRY AND MANUAL ACCOUNTING
UNIT III

ANSWERS FOR ASSIGNMENT SHEETS

ASSIGNMENT SHEET #1

		Debit	Credit
1.	Cash	2,100	
	Hal Wilson, Capital		2,100
2.	Equipment	1,200	
	Cash		700
	Accounts Payable		500
3.	Supplies	80	
	Cash		80
4.	Rent Expense	200	
	Cash		200
5.	Cash	1,500	
	Accounts Receivable	600	
	Sales		2,100
6.	Accounts Payable	300	
	Cash		300
7.	Salary Expense	100	
	Cash		100
8.	Hal Wilson, Drawing	200	
	Cash		200

ASSIGNMENT SHEET #2

	Debit	Credit
Cash	1,200	
Accounts receivable	700	
Prepaid insurance	50	
Supplies	400	
Equipment	5,000	
Notes payable		1,000
Accounts payable		300
Salaries payable		400
Capital stock		4,000
Retained earnings		600
Sales		3,000
Salary expense	1,300	
Rent expense	500	
Miscellaneous expense	150	
	9,300	9,300

DATA ENTRY AND MANUAL ACCOUNTING
UNIT III

EXAMINATION

1. Match the terms in Column B with their correct definitions in Column A.

Column A

____a. A record which summarizes changes resulting from business transactions

____b. A book in which each business transaction is originally entered

____c. Summarizes revenue and expenses to determine net income or net loss for a specified period of time

____d. Summarizes changes in capital over a specified period of time to yield a current capital balance

____e. A business report showing the assets, liabilities, and capital on a specific date

____f. Items of value owned by a business or individual

____g. The equity of the owner in a business

____h. Amounts owed by a business or individual

____i. Revenues exceed expenses

____j. Expenses exceed revenues

____k. The left side of an account

____l. The right side of an account

____m. All of the accounts of a business

____n. Document from which raw or original data is obtained

____o. The recording of human readable data into a form that an input device can interpret for the computer system.

Column B

1. Account
2. Assets
3. Balance sheet
4. Capital
5. Capital statement
6. Credit side
7. Data entry
8. Debit side
9. Income statement
10. Journal
11. Ledger
12. Liabilities
13. Net income
14. Net loss
15. Source document

2. List three examples of source documents and explain the purpose for each.

   a.

   b.

   c.

3. Explain the difference between internal information generators and external information generators.

4. Eleven steps in the completion of the accounting cycle are scrambled below. Place numbers in the blank at the left of each step to show its relative location in the accounting cycle. Use number 1 to indicate the first step in the cycle.

____a. The work sheet is completed.

____b. The transaction is analyzed.

____c. The accounting statements are prepared.

____d. The post-closing trial balance is prepared.

____e. The business transaction occurs.

____f. The journal entry is posted to the appropriate accounts in the ledger.

____g. The adjusting entries are recorded in the journal and posted to the ledger.

____h. The transaction is recorded in the journal.

____i. Trial balance is prepared.

____j. The business document is prepared.

____k. The closing entries are recorded in the journal and posted to the ledger.

5. Describe the media used by each of the following data entry devices:

   a. Keypunch -

   b. Paper tape punch -

   c. Key-to-tape -

   d. Key-to-disk -

   e. Terminals -

6. Three methods to help insure accuracy are available to the data entry operator. They are listed below. Explain how each is used to check accuracy.

   a. Validation -

   b. Verification -

   c. Editing -

7. Explain how the fixed-length field and the variable-length field are different.

8. A data record is a group of related data fields, such as all data pertaining to one employee. List the two different ways a data record can be recorded.

   a.

   b.

9. Presented below are three different sets of data representing special features in data entry. Indicate the special feature each set represents.

   a. Ed Lee
      Arnold Wertlebertle
      Bob Wilson ______________________________

   b. $ 49.60
      8.21
      123.98
      66.49 ______________________________

c. 04960
00821
12398
06649

____

168

DATA ENTRY AND MANUAL ACCOUNTING
UNIT III

ANSWERS TO EXAMINATION

1. a. 1
   b. 10
   c. 9
   d. 5
   e. 3
   f. 2
   g. 4
   h. 12
   i. 13
   j. 14
   k. 8
   l. 6
   m. 11
   n. 15
   o. 7

2. Any source document from Unit III outline, Section II, A-Q

3. Internal - request for information from within the firm.
   External - request for information from outside the firm.

4. a. 7
   b. 3
   c. 8
   d. 11
   e. 1
   f. 5
   g. 9
   h. 4
   i. 6
   j. 2
   k. 10

5. a. Punch card
   b. Paper tape
   c. Magnetic tape
   d. Magnetic disk
   e. Display or printer

6. a. Validation - checking to insure that transaction forms and documents are correct.
   b. Verification - checking data against original document to insure accuracy in entering data.
   c. Editing - data checking for form which can be processed by applications programs.

7. Fixed-length field required enough space for largest data anticipated.
Variable-length field requires only enough space to hold each data element.

8. Fixed-length records and variable-length records

9. a. Left justify
   b. Right justify
   c. Zero fill

THE CENTRAL PROCESSING UNIT
UNIT IV

UNIT OBJECTIVES

After studying this unit, students should be able to understand functions of the central processing unit, internal storage of data, and internal numbering systems.

SPECIFIC OBJECTIVES

After studying this unit. students should be able to:

1. Match terminology with definitions.
2. Recognize functions performed by the control unit, the Arithmetic/Logic Unit, and circuits performing logical operations in the Central Processing Unit.
3. Identify and discuss the differences in the two machine cycles.
4. Identify and define the three types of multiple processors.
5. Match the types of primary storage with their characteristics.
6. List types of electromechanical storage devices.
7. Match the types of secondary storage devices with their characteristics.
8. Match temporary storage fundamentals with their characteristics.
9. Arrange computer storage units in the correct hierarchy of smallest to largest.
10. Select true statements concerning the binary, octal, and hexadecimal systems.
11. Match types of data codes with their descriptions.
12. List uses of the memory dump.

THE CENTRAL PROCESSING UNIT
UNIT IV

SUGGESTED ACTIVITIES

I. Instructor

  A. Make transparencies.

  B. Provide students with objectives and discuss.

  C. Provide students with information and assignment sheets and discuss.

  D. Provide supplementary information and assignments.

  E. Give examination.

II. Student

  A. Read objectives.

  B. Study information sheets as presented and assigned by instructor.

  C. Complete assignment sheets and supplementary assignments.

  D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit content

  A. Objectives

  B. Notes to instructor

  C. Information sheets

  D. Handouts

    1. HO-IV-1: Extended Binary Coded Decimal Interchange Code (EBCDIC)

    2. HO-IV-2: American Standard Code for Information Interchange - 7 (ASCII-7)

    3. HO-IV-3: American Standard Code for Information Interchange - 8 (ASCII-8)

    4. HO-IV-4: Memory Dumps Using EBCDIC Code

E. Transparency masters

1. TM-IV-1: The Heart of the Computer System
2. TM-IV-2: Central Processing Unit (CPU)
3. TM-IV-3: Components of the Central Processing Unit
4. TM-IV-4: Logic Decisions
5. TM-IV-5: Registers
6. TM-IV-6: The Execution of an Instruction
7. TM-IV-7: The Use of Channels
8. TM-IV-8: Minicomputer with Multiple Processors
9. TM-IV-9: One Magnetic Core
10. TM-IV-10: A Magnetized Core On A Core Plane
11. TM-IV-11: Chip Circuit
12. TM-IV-12: Secondary Storage Media
13. TM-IV-13: Temporary Storage Fundamentals
14. TM-IV-14: Character-Addressable Storage Device
15. TM-IV-15: Word-Addressable Storage Device
16. TM-IV-16: Storage Characterisitcs
17. TM-IV-17: Storage Units
18. TM-IV-18: Data Representation
19. TM-IV-19: The Decimal System (Base 10)
20. TM-IV-20: Binary Numbering System (Base 2)
21. TM-IV-21: Comparison of Numbering System Place Values
22. TM-IV-22: Characteristics of Numbering Systems
23. TM-IV-23: The Hexadecimal Numbering System (Base 16)
24. TM-IV-24: Conversion to Decimal[1]
25. TM-IV-25: Conversion to Decimal[2]
26. TM-IV-26: Conversion From a Decimal

F. Assignment sheets

    1. AS-IV-1: The Octal/Binary Short Cut Notation

    2. AS-IV-2: The Hexadecimal/Binary Short Cut Notation

    3. AS-IV-3: Code Conversions

    4. AS-IV-4: Converting to Base 10

G. Answers to assignment sheets

H. Examination

I. Answers to examination

THE CENTRAL PROCESSING UNIT
UNIT IV

NOTES TO THE INSTRUCTOR

TRANSPARENCY #1
The CPU is the "heart" and "brains" of a computer system. All other devices are attached to and controlled by the CPU.

TRANSPARENCY #4
Logic decisions or logical comparisons are made by the Arithmetic/Logic Unit of the CPU. Logical comparison symbols and branching (looping) will be presented in later units.

TRANSPARENCY #7
This transparency illustrates how channels "run interference" for the CPU so that several operations can take place at the same time.

TRANSPARENCY #8
The bus is illustrated here as a communications link between several devices and primary storage (CPU).

The numbering systems section (TM 19 through 26) could be expanded if you wish to place more emphasis on number systems. Examples could be worked through with the students illustrating addition, subtraction, multiplication, and division of binary, octal, and hexadecimal systems. Students get more practice when working with number systems if each element of the calculation is converted to decimal and the calculation is performed in decimal as well. The answer can then be converted from decimal to the number system for accuracy checking or vice versa.

THE CENTRAL PROCESSING UNIT
UNIT IV

INFORMATION SHEET

I. Terms and Definitions

A. Access time - the waiting time between a request for data and the actual data transfer

B. Bus - a group of circuits which provides communication paths between elements of a computer system

C. Control unit - the unit which controls and supervises the entire computer system

D. Data adaptors - devices that convert data from the form used by the input device to the form required by the computer system

E. Execution time (E-time) - the time required for the computer to perform the instruction

F. Instruction time (I-time) - the time required to bring an instruction into the control unit and decode the instruction

G. Megabyte - one million characters or bytes

H. Multiprocessing - a system utilizing more than one CPU in the same system

I. Nibble - term given to 4 bits or one-half an 8-bit byte

J. Nonvolatile storage - storage in which contents are retained if power or current is turned off

K. Operand - a name portion which tells the CPU location of data to be manipulated

L. Operation code - code which tells the computer which operation to perform

M. Parallel operation - concurrent execution of two or more operations in the Arithmetic/Logic Unit (ALU)

N. Serial operation - type of information transfer which performs operation on digits sequentially

O. Transfer time - the time required to move data from one location to another location

P. Virtual storage - storage which allows the programmer to use secondary storage to store programs or parts of programs that require more primary storage than is available

Q. Volatile temporary storage - storage in which loss of power or current causes loss of all data and information stored

II. Functions of the Central Processing Unit (CPU) (Refer to TM-IV-1, TM-IV-2, and TM-IV-3.)

A. Control unit - controls and supervises the entire computer system

1. Directs and controls all devices according to a computer program

2. Decodes instructions

3. Activates appropriate circuits

a. Input and output devices

1) Data adaptors - devices that convert data from the form used by the input device to the form required by the computer system. Also convert from machine format to the form required by the output device.

b. Data movement to and from storage

c. Data movement to and from Arithmetic/Logic Unit (ALU)

B. Arithmetic/Logic Unit - handles the computing and logical operations in the CPU

1. Contains circuits to perform arithmetic operations

a. Calculates

b. Shifts digits

c. Sets algebraic sign of numbers

d. Rounds figures

e. Serial operation - performs operation on one digit at a time

Example: 13 + 22 =
Step 1: Adds 3 + 2 = 5
Step 2: Adds 1 + 2 = 3 Result 3 and 5 or 35

f. Parallel operation - performs more than one operation simultaneously

g. Fixed-point decimal

1) Computer knows location of decimal point ahead of time.

2) Location specified in computer program

h. Floating-point decimal

1) Computer does not know decimal location ahead of time.

2) Data must be entered with decimal point in correct location.

2. Contains circuits to perform logical operations (Refer to TM-IV-4.)

a. Decision-making operations (comparisons)

b. Changes sequence of instructions in program

C. Provides primary storage for data and programs (instructions)

1. Registers

a. Hold data, instructions, or results temporarily located in the CPU

b. Usually hold one number or one instruction

c. Number and function of registers differ with different computers

2. Types of registers (Refer to TM-IV-5.)

a. General purpose - used several different ways

b. Accumulator - holds results of arithmetic operations

c. Instruction - holds an instruction until executed

d. Storage - holds data until processed

e. Address - stores location of an instruction to be executed

f. Privileged - used only by computer system, cannot be used by programmer or operator

III. Two Machine Cycles (Refer to TM-IV-6.)

A. Instruction time (I-time) - the time required to bring an instruction into the control unit and decode the instruction

1. Operation code - tells the computer which operation to perform

2. Operand - tells the CPU location of data to be manipulated

B. Execution time (E-time) - the time required for the computer to perform the instruction

   1. Access time - the waiting time between a request for data and the actual data transfer

   2. Transfer time - the time required to move data from one location to another location once movement of data begins

IV. Multiple processors (Refer to TM-IV-7.)

A. Channels - make it possible for the computer to accept input, perform processing, and output information on the same or different programs at the same time.

B. Multiprocessing - a system utilizing more than one CPU in the same system for simultaneous operations

C. Bus - a group of circuits which provide communication paths between elements of a computer system (Refer to TM-IV-8.)

V. Primary storage (primary memory, main memory, core storage, etc.) (Refer to TM-IV-9 and TM-IV-10.)

A. Relatively expensive

B. Short access times

C. Magnetic core storage

   1. Tiny doughnut-shaped ferrite rings

   2. Wire through center of ring

   3. Electrical current magnetizes ring

   4. Direction of current flow determines "on" or "off" state

   5. Cores (rings) are strung together on wires in core planes to represent character binary codes.

   6. Number of cores per plane and number of planes determine size of primary storage

D. Semiconductor - current passes through circuits printed on a chip (Refer to TM-IV-11.)

   1. Newer technology than magnetic core

   2. Access times less than magnetic core

   3. Requires less space for same capacity as magnetic core

VI. Electromechanical Storage Devices (Secondary Storage, Peripheral Storage, Auxiliary Storage, etc.) (Refer to TM-IV-12.)

   A. Magnetic tape

   B. Magnetic disk

   C. Magnetic drum

VII. Electronic Secondary Storage

   A. Faster access speeds than electromechanical storage

   B. Slower access speeds than primary storage

   C. Magnetic Bubble Memory (MBM)

      1. Cylindrical regions formed by magnetic fields

      2. Presence or absence of a bubble indicates "on" or "off" state

      3. Bubble moved electronically to store and access data

   D. Charge Coupled Device (CCD) - a semiconductor that uses electrons within a metal oxide semiconductor crystal to store data

   E. Electron Beam Addressed Memory (EBAM) - electrical circuits control an electron beam that reads from or writes on a metal oxide semiconductor surface

   F. Virtual storage - allows the programmer to use secondary storage to store programs or parts of programs that require more primary storage than is available

VIII. Temporary Storage Fundamentals (Refer to TM-IV-13.)

   A. Locations - the place where data and instructions are stored

   B. Contents - data and instructions stored under an address location

   C. Variable-word length - word size will vary in the amount of information contained (Refer to TM-IV-14.)

   D. Fixed-word length - word size always contains same amount of information (Refer to TM-IV-15.)

      1. Inefficient in terms of storage space compared with variable-word length

      2. Faster access speed than variable-word length

E. Random Access Memory (RAM) (Refer to TM-IV-16.)

1. Data stored to be accessed directly at a later time

2. Read Only Memory (ROM) is usually random access.

3. Instructions contained on memory chips in circuits

4. Computer manufacturer supplies chips.

5. Special procedures to reprogram chips (PROM - Programmable Read Only Memory)

F. Nondestructive output - output from temporary storage does not destroy original copy in temporary storage

G. Destructive reading - old data is replaced when new data is read into same location (read-in, destruct principle)

H. Volatile temporary storage - loss of power or current causes loss of all data and information stored

I. Nonvolatile storage - contents are retained if power or current is turned off

IX. Hierarchy of Storage (Refer to TM-IV-17.)

A. Bit (Binary digit)

1. One binary piece of information - a magnetic spot on disk or in main memory

2. May require several bits to represent a character

B. Byte

1. Usually 8 bits, 9 bits if parity check is used

2. Computer may use a byte to represent a character.

3. Computers may require 6, 7, or 8 bits for a byte.

C. Nibble - term given to 4 bits or one-half an 8-bit byte

D. Computer word - a character string or a binary element string that is convenient for some purpose to consider as an entity

1. Commonly 32 bits or four 8-bit bytes

2. Number of bytes per word varies with different computers.

3. Words generally vary from 16 to 64 bits depending on size and make of computer.

E. Megabyte - one million bytes

Example: 1 megabyte equals 1,000,000 bytes

X. Internal Numbering Systems (Refer to TM-IV-18, TM-IV-19, TM-IV-20, TM-IV-21 and TM-IV-22.)

A. Binary (Refer to AS-IV-1 and AS-IV-2.)

1. Only two conditions or states; (on-off), (yes-no), (magnetized-not magnetized)

2. Base two numbering system uses only 1 or 0 to represent "on" or "off."

3. Position of digit 1 determines value.

   Example of values: 256, 128, 64, 32, 16, 8, 4, 2, 1

   a. The extreme right position is always equal to 1.

   b. Multiply position value by base of 2 to find next left position value.

B. Octal

1. Base 8 numbering system

2. Largest value represented is 7.

3. Uses digits 0 through 7

4. One octal position equals three binary positions.

5. Position of digit determines value.

   Example of values: 4096, 512, 64, 8, 1

   a. The extreme right position is always equal to 1.

   b. Multiply position value by base of 8 to find next left position value.

C. Hexadecimal (Refer to TM-IV-23.)

1. Base 16 numbering system

2. Largest value represented is 15.

3. Uses 10 digits (0 through 9) to represent themselves

4. Uses letters A through F to represent value of 10 through 15

5. One hexadecimal position equals 4 binary positions

6. Position values are: 65536, 4096, 256, 16, 1

   a. The extreme right position is always equal to the value of 1.

   b. Multiply position value by base of 16 to find next left position value.

XI. Internal Data Codes

A. Binary Coded Decimal Interchange Code (BCDIC)

1. Used in 96-column card as BCD code

2. 6-bit code - requires memory groups of 6 binary digits

3. Possible to represent 64 letters, digits, and/or special characters

4. Derived from Hollerith Code on 80-column card

5. Octal numbering system is used as a shortcut notation for BCDIC.

B. Extended Binary Coded Decimal Interchange Code (EBCDIC) (Refer to HO-IV-1 and AS-IV-3.)

1. 8-bit code

2. Possible to represent 256 letters, digits, and/or special characters

3. Widely used code

4. Essential if utilizing system for word processing

5. Derived from Hollerith Code

6. 4 zone bits on left

7. 4 numeric bits on right

   a. Characters 0 through 9

      1) 4 zone bits "on" or "1"
      2) Numeric bits are 0000 through 1001.

   b. Characters A through I

      1) Zone bits are 1100.
      2) Numeric bits are 0001 through 1001.

c. Characters J through R

   1) Zone bits are 1101.
   2) Numeric bits are 0001 through 1001.

c. Characters S through Z

   1) Zone bits are 1110.
   2) Numeric bits are 0010 through 1001.

8. Hexadecimal numbering system is a shortcut notation for EBCDIC.

9. Packed decimal format (Refer to TM-IV-24, TM-IV-25, TM-IV-26 and AS-IV-4.)

   a. Zone bits not used with numeric data

   b. Store two digits in each 8-bit byte.

   c. Low order bits used for sign

      1) Positive number is 1111.
      2) Negative number is 1101.

C. American Standard Code for Information Interchange-7 (ASCII-7) (Refer to HO-IV-2.)

   1. Not based on Hollerith Code

   2. 7-bit code

      a. First three bits represent zone.

      b. Last four bits represent digit.

   3. Possible to represent 128 characters

   4. Uses hexadecimal shortcut notation

D. American Standard Code for Information Interchange-8 (ASCII-8) (Refer to HO-IV-3.)

   1. Newer version of ASCII-7

   2. Uses 8-bit code

   3. Has 256 character choices

   4. Four zone and four digit bits

   5. Uses hexadecimal shortcut notation

XII. Memory Dump (Refer to HO-IV-4.)

A. A printout of the contents of computer memory

B. Dump is in internal code of computer.

  1. Binary values

  2. Octal

  3. Hexadecimal

C. Used by programmer to locate errors when all else fails

D. Programmer must interpret data in dump according to code.

E. Data addresses and data are indicated.

HO-IV-1

Extended Binary Coded Decimal Interchange Code (EBCDIC)

Character	EBCDIC	Character	EBCDIC
0	1111 0000	I	1100 1001
1	1111 0001	J	1101 0001
2	1111 0010	K	1101 0010
3	1111 0011	L	1101 0011
4	1111 0100	M	1101 0100
5	1111 0101	N	1101 0101
6	1111 0110	O	1101 0110
7	1111 0111	P	1101 0111
8	1111 1000	Q	1101 1000
9	1111 1001	R	1101 1001
A	1100 0001	S	1110 0010
B	1100 0010	T	1110 0011
C	1100 0011	U	1110 0100
D	1100 0100	V	1110 0101
E	1100 0101	W	1110 0110
F	1100 0110	X	1110 0111
G	1100 0111	Y	1110 1000
H	1100 1000	Z	1110 1001

American Standard Code for Information Interchange - 7 (ASCII - 7)

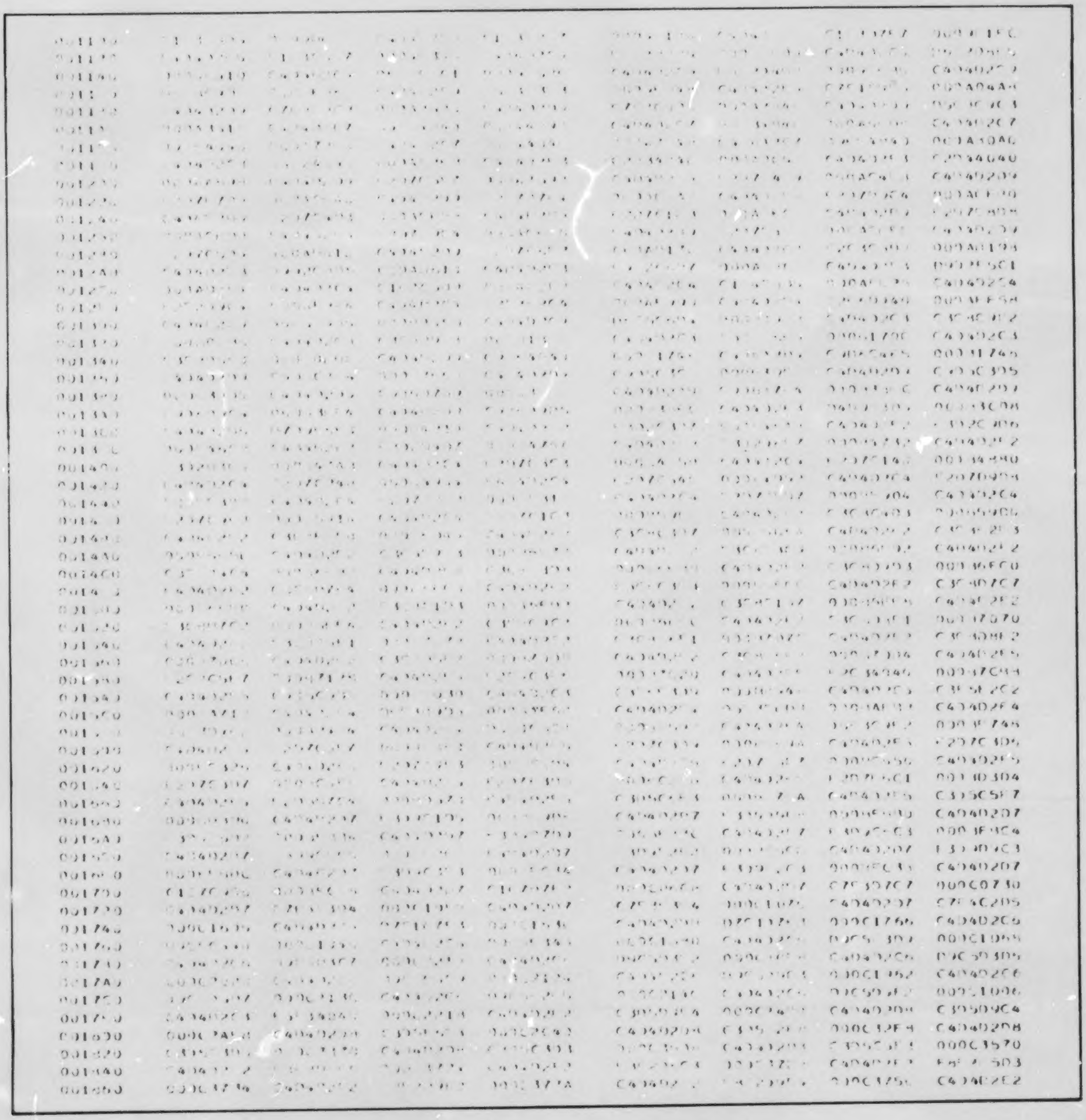
	Binary				Binary		
Character	**Zone**	**Digit**	**Hexadecimal**	**Character**	**Zone**	**Digit**	**Hexadecimal**
0	011	0000	30	J	100	1010	4A
1	011	0001	31	K	100	1011	4B
2	011	0010	32	L	100	1100	4C
3	011	0011	33	M	100	1101	4D
4	011	0100	34	N	100	1110	4E
5	011	0101	35	O	100	1111	4F
6	011	0110	36	P	101	0000	50
7	011	0111	37	Q	101	0001	51
8	011	1000	38	R	101	0010	52
9	011	1001	39	S	101	0011	53
A	100	0001	41	T	101	0100	54
B	100	0010	42	U	101	0101	55
C	100	0011	43	V	101	0110	56
D	100	0100	44	W	101	0111	57
E	100	0101	45	X	101	1000	58
F	100	0110	46	Y	101	1001	59
G	100	0111	47	Z	101	1010	5A
H	100	1000	48				
I	100	1001	49				

American Standard Code for Information Interchange - 8 (ASCII - 8)

	Binary				Binary		
Character	**Zone**	**Digit**	**Hexadecimal**	**Character**	**Zone**	**Digit**	**Hexadecimal**
0	0101	0000	50	J	1010	1010	AA
1	0101	0001	51	K	1010	1011	AB
2	0101	0010	52	L	1010	1100	AC
3	0101	0011	53	M	1010	1101	AD
4	0101	0100	54	N	1010	1110	AE
5	0101	0101	55	O	1010	1111	AF
6	0101	0110	56	P	1011	0000	B0
7	0101	0111	57	Q	1011	0001	B1
8	0101	1000	58	R	1011	0010	B2
9	0101	1001	59	S	1011	0011	B3
A	1010	0001	A1	T	1011	0100	B4
B	1010	0010	A2	U	1011	0101	B5
C	1010	0011	A3	V	1011	0110	B6
D	1010	0100	A4	W	1011	0111	B7
E	1010	0101	A5	X	1011	1000	B8
F	1010	0110	A6	Y	1011	1001	B9
G	1010	0111	A7	Z	1011	1010	BA
H	1010	1000	A8				
I	1010	1001	A9				

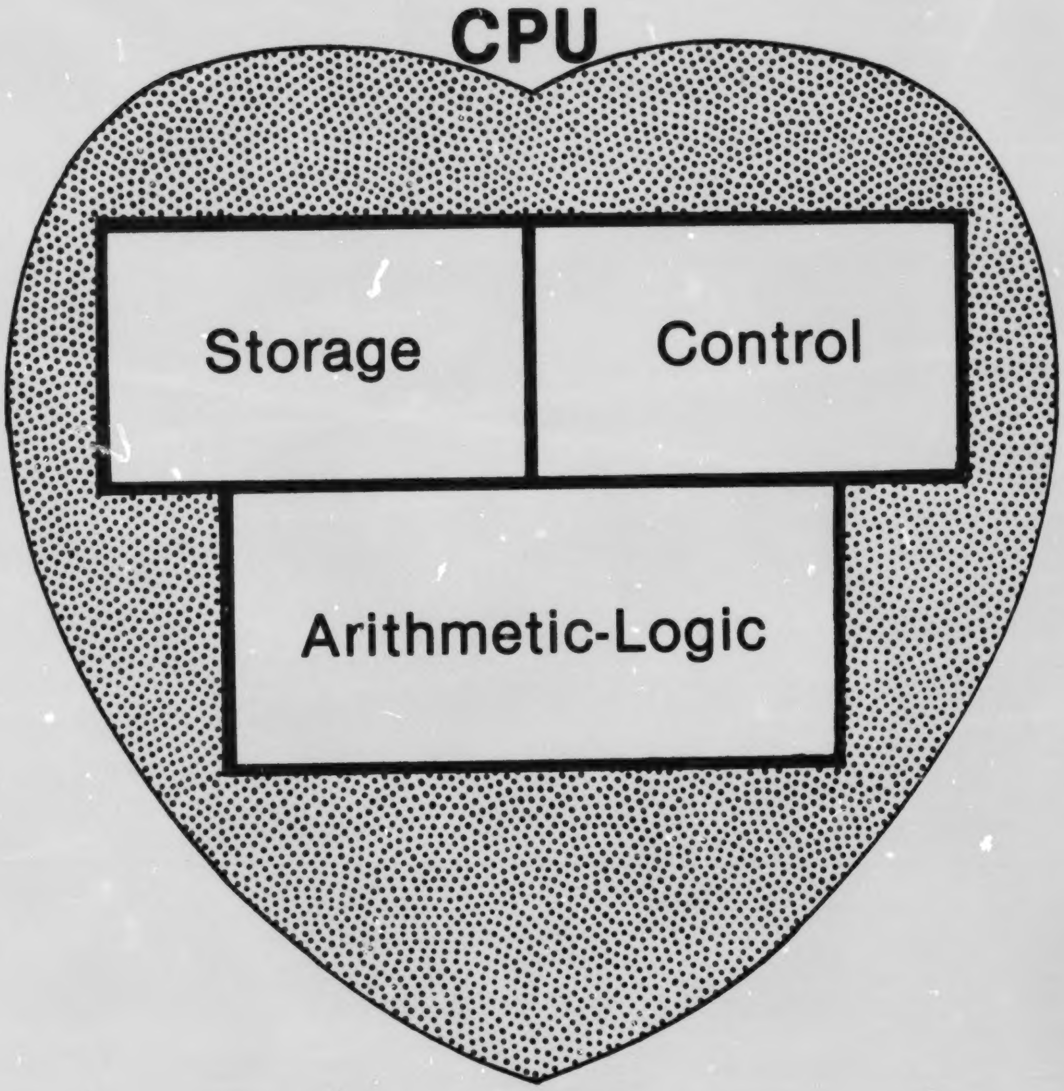
HO-IV-4

Memory Dumps Using EBCDIC Code



TM-IV-1

The Heart of the Computer System


CPU
Storage
Control
Arithmetic-Logic

Central Processing Unit (CPU)

CENTRAL PROCESSOR

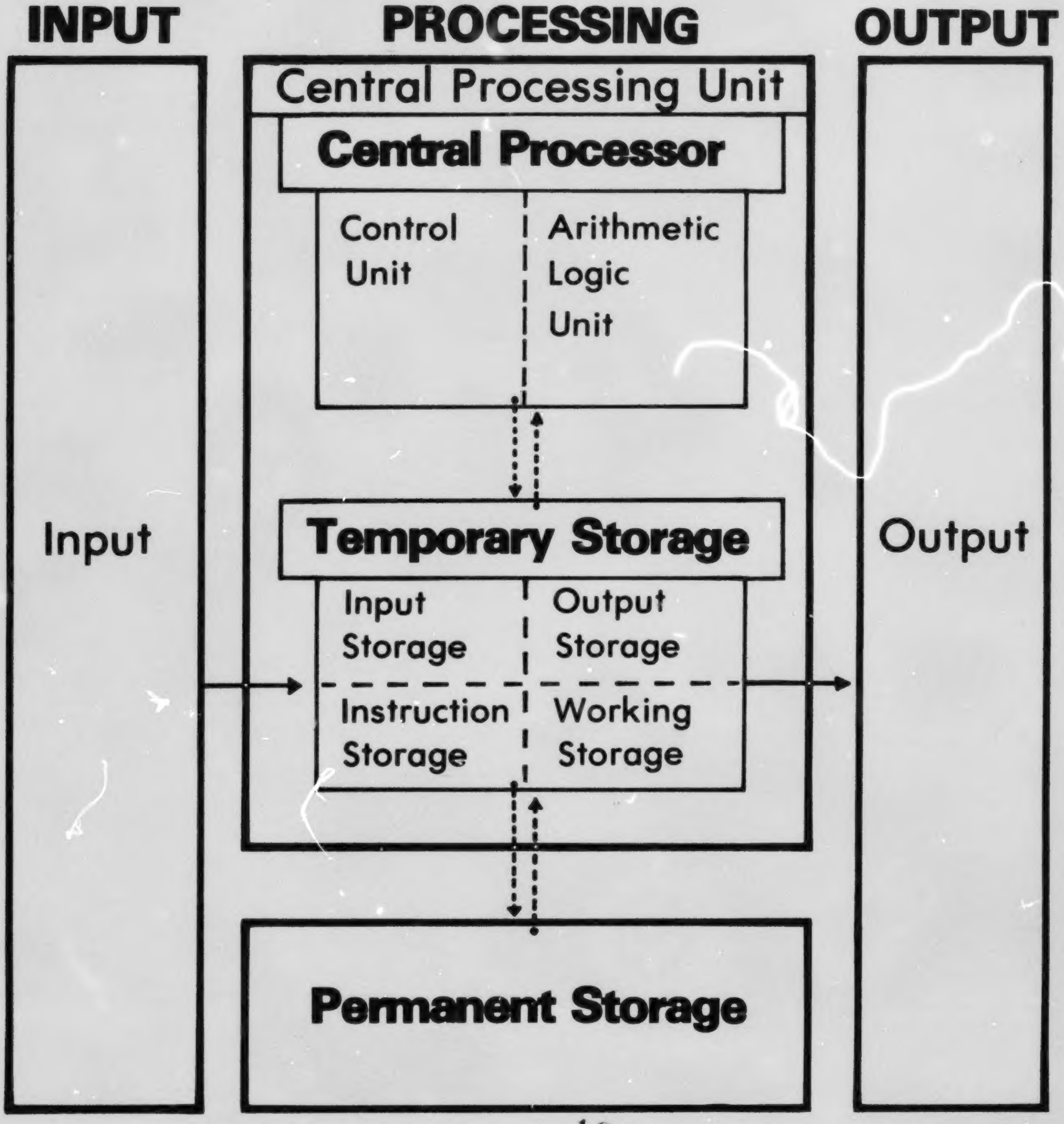
- Control Unit
- Arithmetic/Logic Unit

TEMPORARY STORAGE

- Input Storage
- Output Storage
- Instruction Storage
- Working Storage

TM-IV-3

Components of the Central Processing Unit


INPUT
PROCESSING
OUTPUT
Input
Central Processing Unit
Central Processor
Control Unit
Arithmetic Logic Unit
Temporary Storage
Input Storage
Output Storage
Instruction Storage
Working Storage
Permanent Storage
Output

TM-IV-4

Logic Decisions

Storage

A	B
500	500

1. Are A and B equal?
2. Are A and B not equal?
3. Is A less than B?
4. Is A greater than B?
5. Is A less than or equal to B?
6. Is A greater than or equal to B?

Registers

GENERAL PURPOSE

ACCUMULATOR

INSTRUCTION

STORAGE

ADDRESS

PRIVILEGED

The Execution of an Instruction

OP CODE	**OPERANDS**

Instruction Cycle

Instruction Time

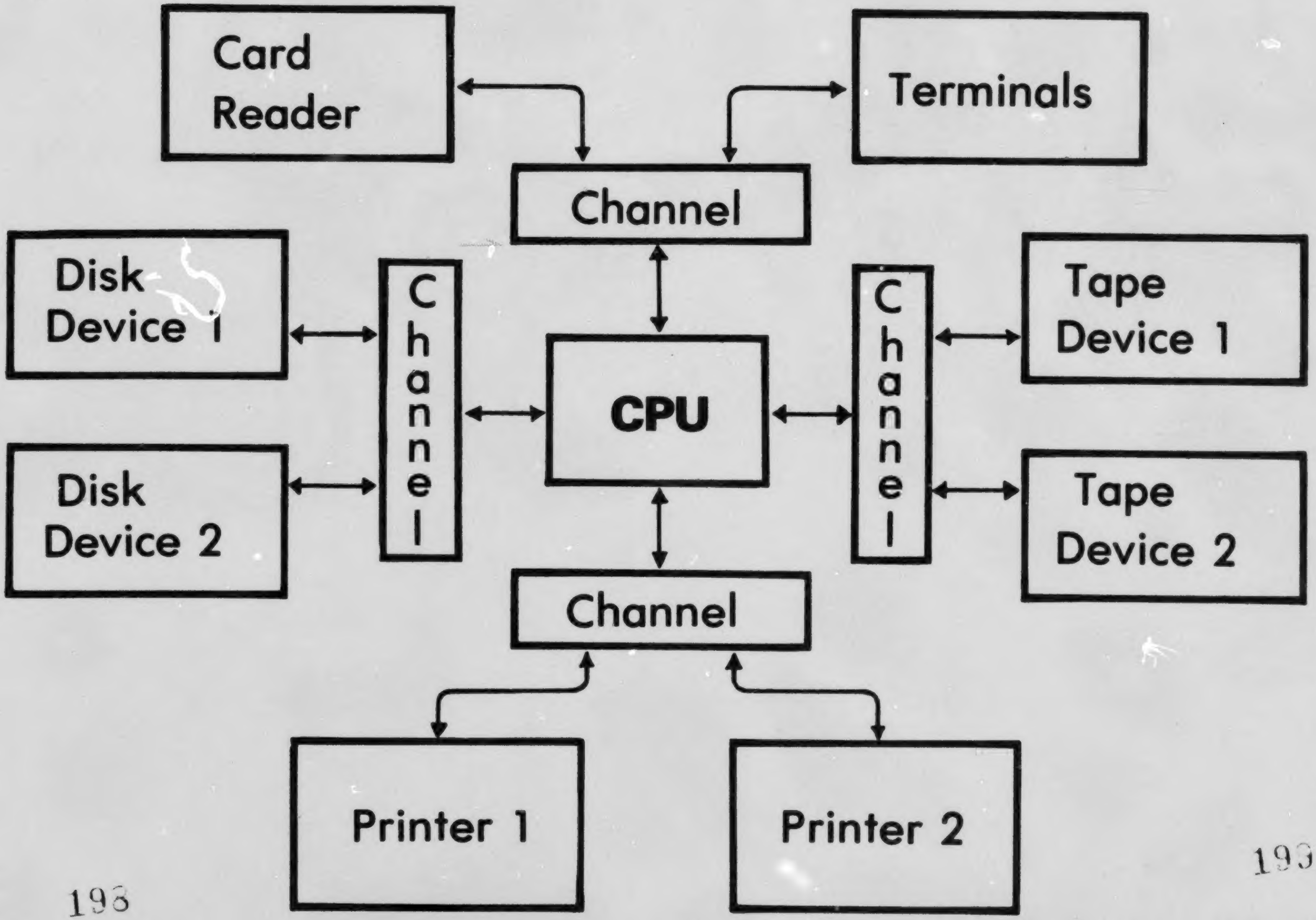
(I-TIME)

Execution Cycle

Execution Time

(E-TIME)

The Use of Channels



Card Reader

Terminals

Channel

Disk Device 1

Channel

CPU

Channel

Tape Device 1

Disk Device 2

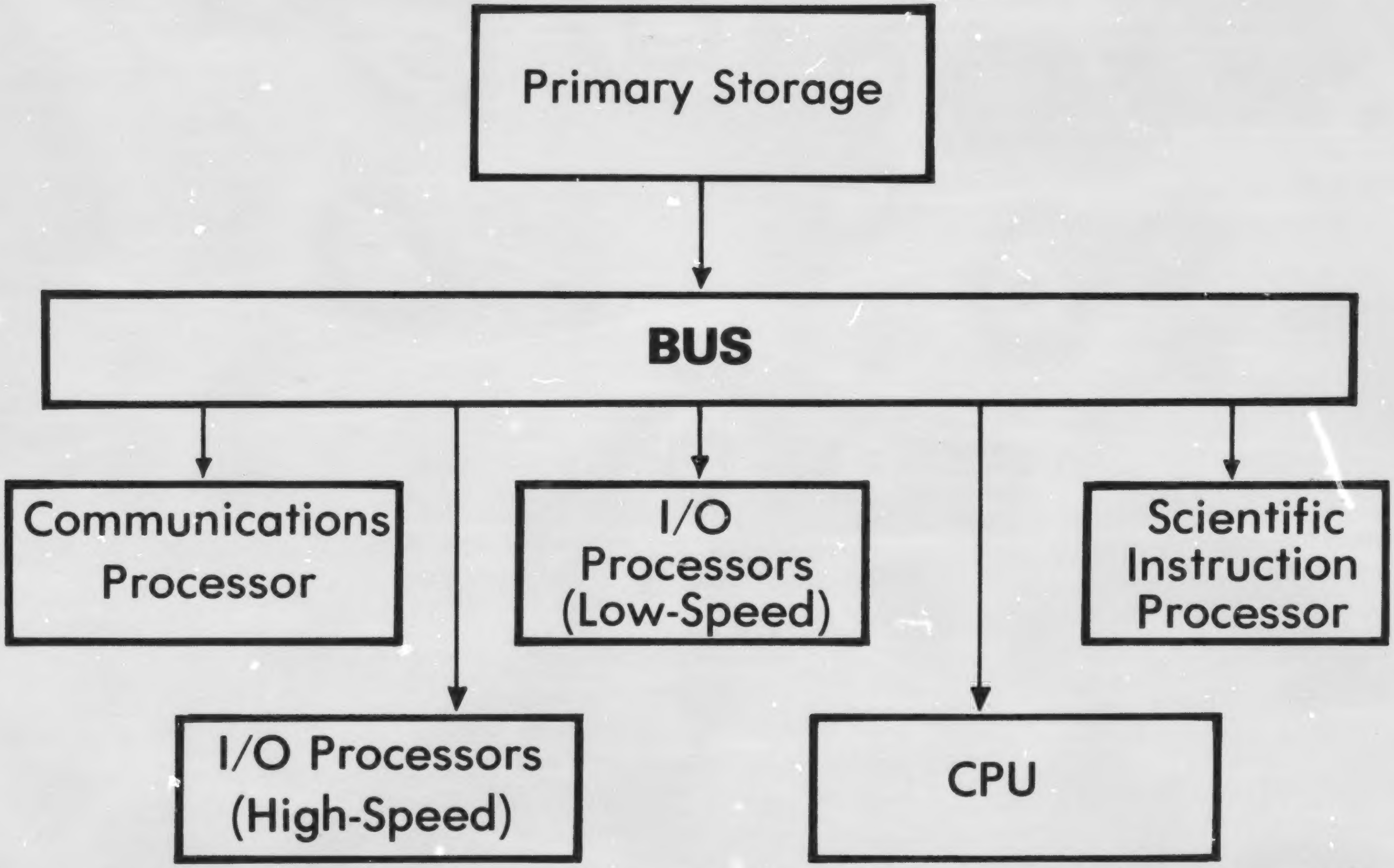
Tape Device 2

Channel

Printer 1

Printer 2

Minicomputer with Multiple Processors



Primary Storage

BUS

Communications Processor

I/O Processors (Low-Speed)

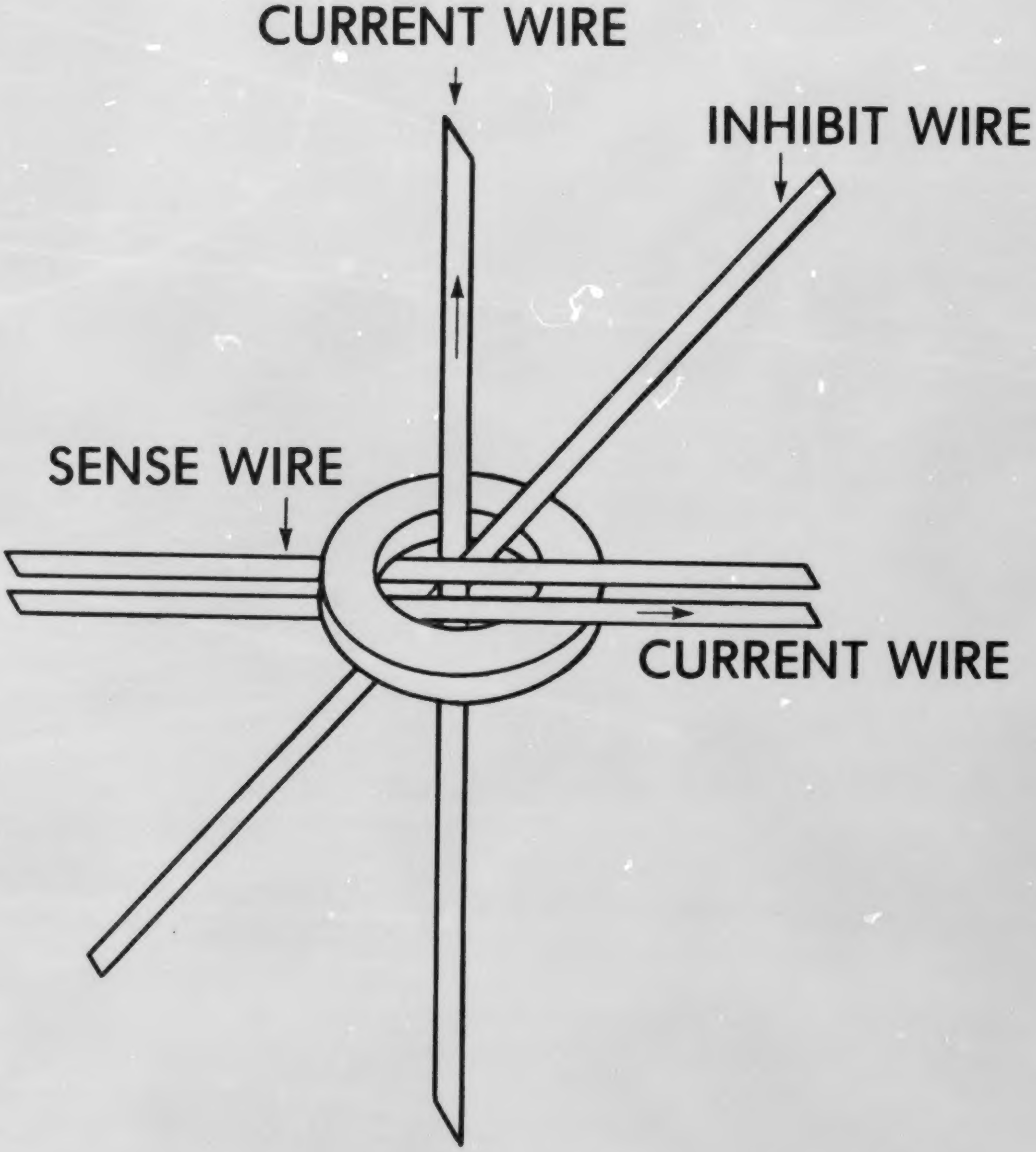
Scientific Instruction Processor

I/O Processors (High-Speed)

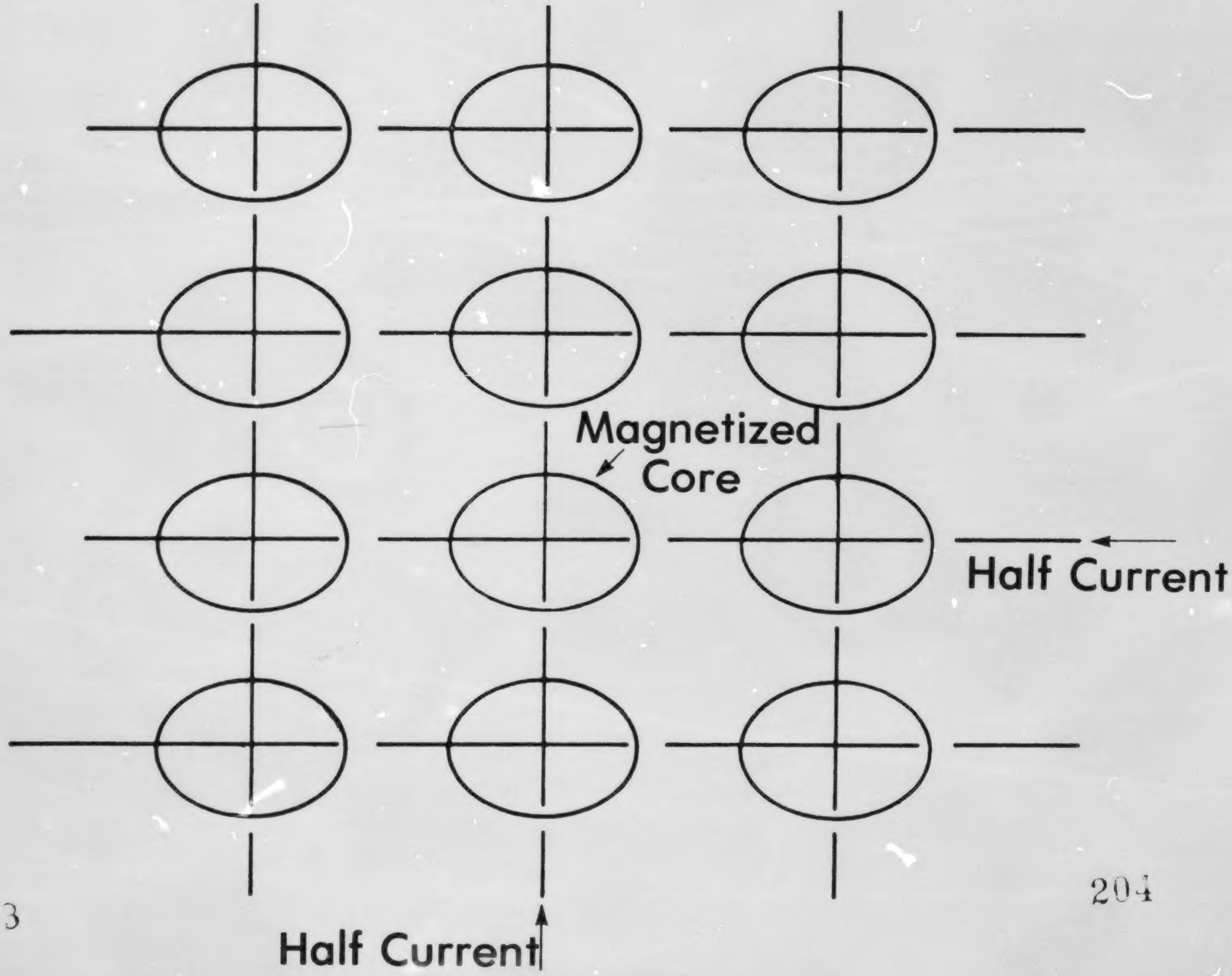
CPU

TM-IV-8

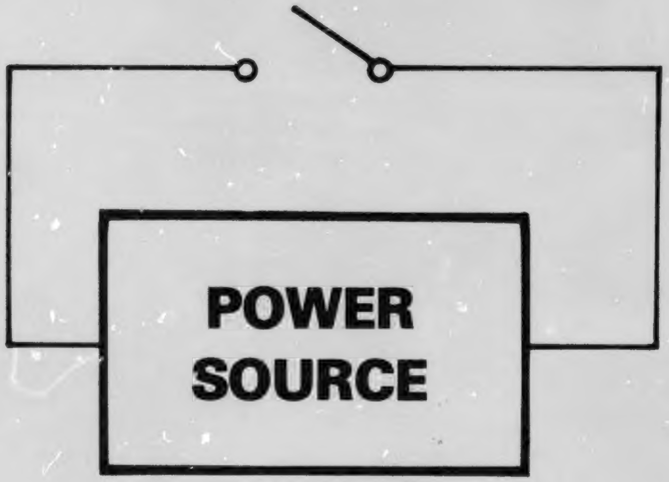
One Magnetic Core


CURRENT WIRE
INHIBIT WIRE
SENSE WIRE
CURRENT WIRE

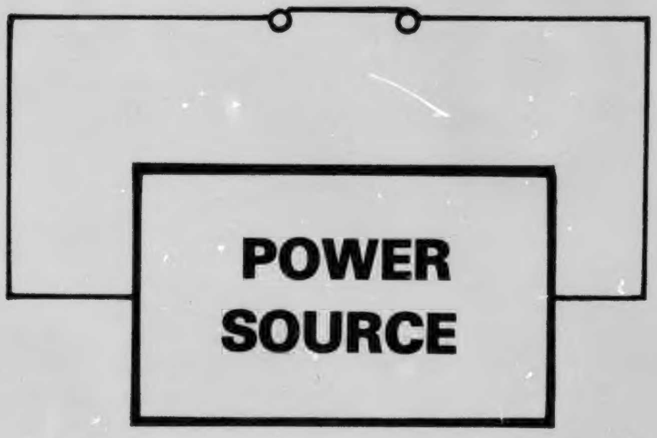
A Magnetized Core on a Core Plane


Magnetized Core
Half Current
Half Current

Chip Circuit

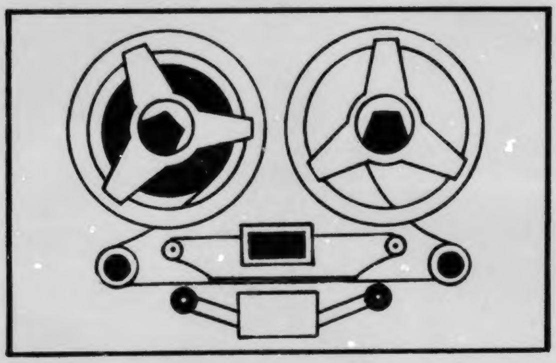

POWER
SOURCE

Switch is Open
(Off or "0" Position)


POWER
SOURCE

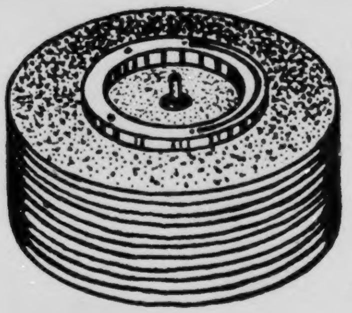
Switch is Closed
(On or "1" Position)

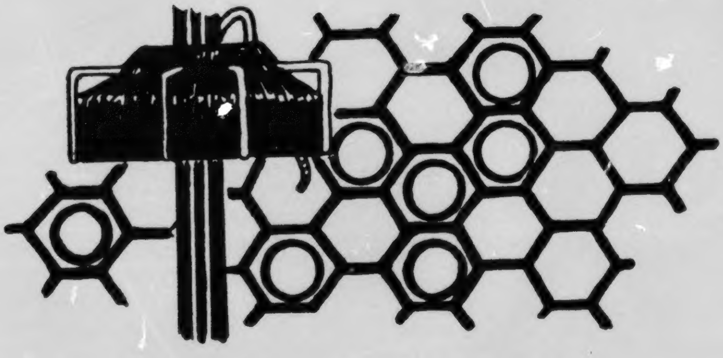
Secondary Storage Media



MAGNETIC TAPE

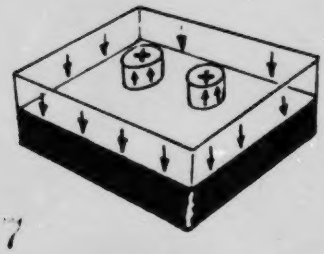
MAGNETIC DISK





MASS STORAGE

MAGNETIC BUBBLE



Temporary Storage Fundamentals

Address

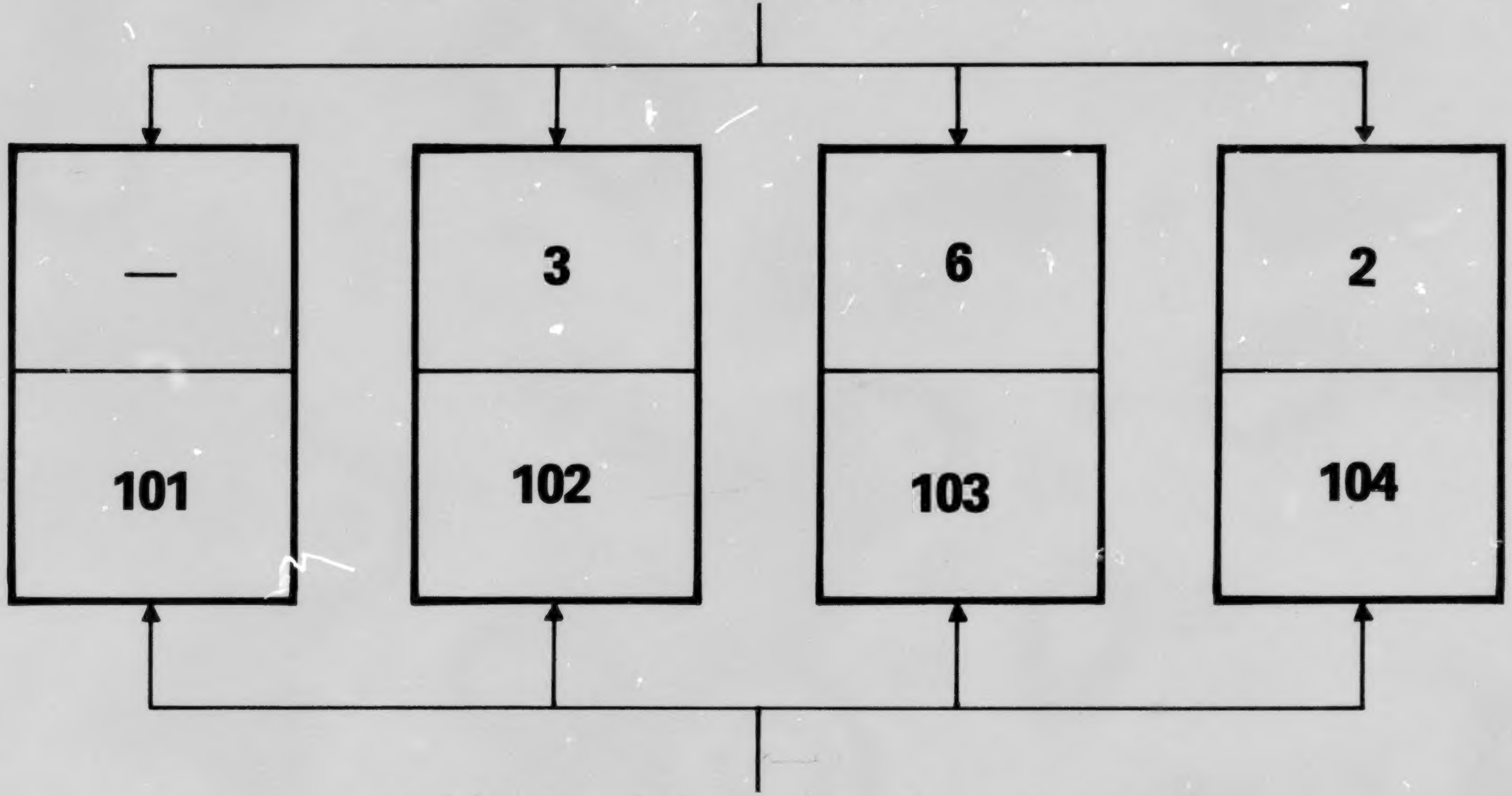
Contents

Character Addressable
(Variable Word Length)

Word Addressable
(Fixed Word Length)

208

Character-Addressable Storage Device



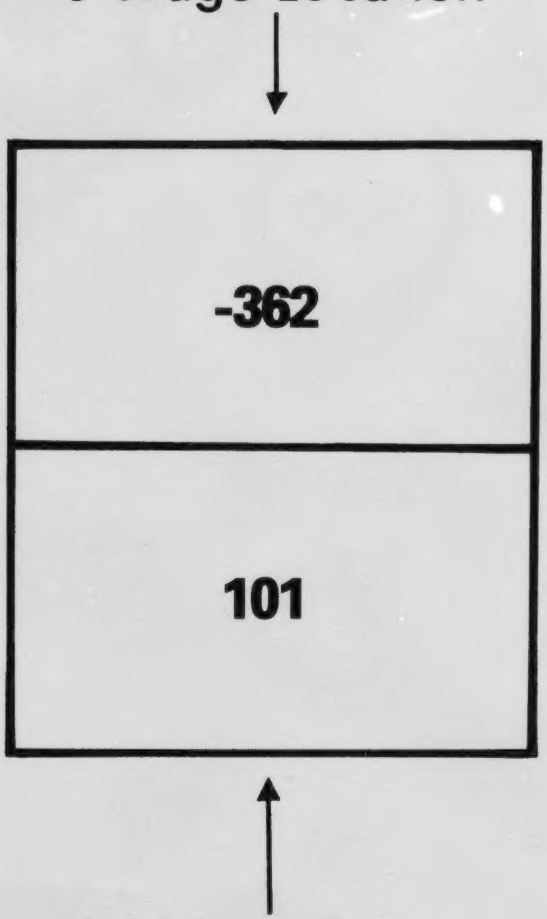
Contents of 4 Storage Locations

—	3	6	2
101	102	103	104

Address of 4 Storage Locations

TM-IV-14

Word-Addressable Storage Device



Contents of One
Storage Location

-362

101

Address of One
Storage Location

TM-IV-16

Storage Characteristics

RAM

ROM

PROM

FIRMWARE

DESTRUCTIVE
(READ-IN)

NONDESTRUCTIVE
(WRITING)

VOLATILE

NONVOLATILE

Storage Units

BIT → BINARY DIGIT (0,1)

NIBBLE → 4 BITS

BYTE → 8 BITS

WORDS →

BLOCKS →

DEFINITION VARIES

K → 1,024

32K → 32,768

MEGA → MILLION

10 MEGABYTES

→ 10 MILLION BYTES

Data Representation

DECIMAL

BINARY

OCTAL

HEXADECIMAL

BINARY CODED DECIMAL SYSTEMS

6-BIT

7-BIT

8-BIT

EBCDIC

ASCII

PARITY CHECKING

The Decimal System

(Base 10)

THE 10 ALLOWABLE CHARACTERS ARE :

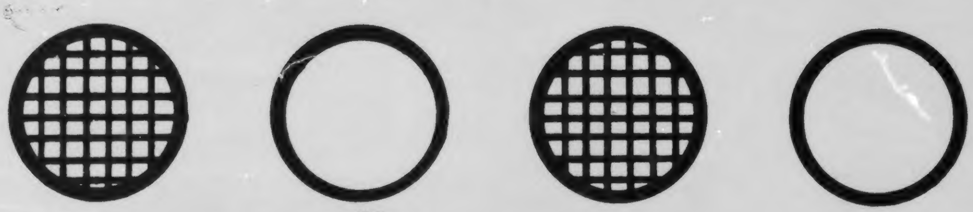
0,1,2,3,4,5,6,7,8,9

Thousands	Hundreds	Tens	Ones	Places
10^3	10^2	10^1	10^0	POWERS
1000	100	10	1	VALUES
		1	3	number is 13

$$1(10) + 3(1) = 13$$

Binary Numbering System
(Base 2)

Place Value:	8	4	2	1



on	off	on	off
1	0	1	0

Binary Number 1010 = Decimal Number 10

(8 + 2)

Comparison of Numbering System Place Values

General	BASE^4	BASE^3	BASE^2	BASE^1	BASE^0
Base 10					
	10^4	10^3	10^2	10^1	10^0
	10,000	1,000	100	10	1
Base 2					
	2^4	2^3	2^2	2^1	2^0
	16	8	4	2	1
Base 8					
	8^4	8^3	8^2	8^1	8^0
	4,096	512	64	8	1
Base 16					
	16^4	16^3	16^2	16^1	16^0
	65,536	4,096	256	16	1

Characteristics of Numbering Systems

Decimal

Base 10

10 digit choices
0, 1, 2, 3, 4, 5, 6, 7, 8, 9
largest single digit is 9

Binary

Base 2

2 digit choices
0, 1
largest single digit is 1

Octal

Base 8

8 digit choices
0, 1, 2, 3, 4, 5, 6, 7
largest single digit is 7

Hexadecimal

Base 16

16 digit choices
0, 1, 2, 3, 4, 5, 6, 7, 8, 9,
A, B, C, D, E, F
largest single digit is F (15)

Digit choices always equal base.

Largest single digit always one less than base.

The Hexadecimal Numbering System (Base 16)

HEXADECIMAL	BINARY	DECIMAL
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
B	1011	11
C	1100	12
D	1101	13
E	1110	14
F	1111	15

TM-IV-24

Conversion to Decimal[1]

Binary Number: 1100 = ?

Step 1. Determine column values

8	4	2	1
1	1	0	0

Step 2. Multiply column values times column digits =

$$\begin{array}{cccc} 8 & 4 & 2 & 1 \\ \underline{\times 1} & \underline{\times 1} & \underline{\times 0} & \underline{\times 0} \\ 8 & 4 & 0 & 0 \end{array}$$

Step 3. Add the products 8 + 4 + 0 + 0 = 12

Octal Number: 146 = ?

Step 1. Determine column values

64	8	1
1	4	6

Step 2. Multiply column values times column digits =

$$\begin{array}{ccc} 64 & 8 & 1 \\ \underline{\times 1} & \underline{\times 4} & \underline{\times 6} \\ 64 & 32 & 6 \end{array}$$

Step 3. Add the products 64 + 32 + 6 = 102

TM-IV-25

Conversion to Decimal^2

Hexadecimal Number: 2A4D = ?

Step 1. Determine column values

4,096	256	16	1
2	10	4	13

Step 2. Multiply column values times column digits

4,096	256	16	1
x2	x10	x4	x13
8,192	2,560	64	13

Step 3. Add the products

8,192 + 2,560 + 64 + 13 = 10,829

Conversion From a Decimal

Step 1: Divide the decimal number to be converted by the number of the new base.

Step 2: Remainder of division in Step 1 is the extreme right digit.

Step 3: Divide the answer from Step 1 by the number of the new base.

Step 4: Remainder of division in Step 3 is the next digit to left. If the answer was zero, stop; otherwise repeat Steps 3 and 4 until answer is zero.

Example: $26_{10} = ?_2$

$1 \div 2 = 0$	$3 \div 2 = 1$	$6 \div 2 = 3$	$13 \div 2 = 6$	$26 \div 2 = 13$
Remainder 1	Remainder 1	Remainder 0	Remainder 1	Remainder 0

Decimal 26 is equal to binary 11010.

Example: $416_{10} = ?_8$

$6 \div 8 = 0$	$52 \div 8 = 6$	$416 \div 8 = 52$
Remainder 6	Remainder 4	Remainder 0

Decimal 416 is equal to octal 640.

Example: $941_{10} = ?_{16}$

$3 \div 16 = 0$	$58 \div 16 = 3$	$941 \div 16 = 58$
Remainder 3	Remainder $10 = A$	Remainder $13 = D$

Decimal 941 is equal to hexadecimal 3AD.

THE CENTRAL PROCESSING UNIT
UNIT IV

ASSIGNMENT SHEET #1: THE OCTAL/BINARY SHORT CUT NOTATION

Directions: Complete the following exercises.

A. Using the instructions given below, calculate the octal short cut notation for each binary number.

Step 1 - Divide the binary digits into groups of three beginning at the right side.	1 1 0	$0\ 1\ 1_2$
Step 2 - Convert each group of three into an octal number using binary place values.	4 2 0	0 2 1
Binary 110011 is equal to octal 63.	6	3_8

1. 101110_2 is equal to ____________$_8$

2. 010100110_2 is equal to ____________$_8$

B. Using the instructions given below, convert the octal numbers to binary numbers.

Step 1 - Convert each octal digit to a 3-digit binary number using binary place values.	6	3
	4 2 0	0 2 1
Step 2 - Run each 3-digit group together into a single binary number.	1 1 0	0 1 1

Octal 63 is equal to binary 110011.

1. 75_8 is equal to __________$_2$

2. 123_8 is equal to __________$_2$

THE CENTRAL PROCESSING UNIT
UNIT IV

ASSIGNMENT SHEET #2: THE HEXADECIMAL/BINARY SHORT CUT NOTATION

Directions: Complete the following exercises.

A. Using the instructions given below, calculate the hexadecimal short cut notation for each binary number.

Step 1 - Divide the binary digits into groups of four beginning at the right side.

1 1 0 1 0 1 1 1

Step 2 - Convert each group of four into a hexadecimal number using binary place values.

8 4 0 1 0 4 2 1

13 = D 7

Binary 11010111 is equal to hexadecimal D7.

1. 11000101_2 is equal to ____________$_{16}$

2. 001010101100_2 is equal to ____________$_{16}$

B. Using the instructions given below, convert the hexadecimal numbers to binary numbers.

Step 1 - Convert each hexadecimal digit to a 4-digit binary number using binary place values.

D = 13 7

8 4 0 1 0 4 2 1

Step 2 - Run each 4-digit group together into a single binary number.

1 1 0 1 0 1 1 1

Hexadecimal D7 is equal to binary 11010111.

1. $B6_{16}$ is equal to ____________$_2$

2. $2A9_{16}$ is equal to ____________$_2$

THE CENTRAL PROCESSING UNIT
UNIT IV

ASSIGNMENT SHEET #3: CODE CONVERSIONS

Directions: Complete the following exercises.

A. Using HO-IV-1 for the necessary code, convert the following line of EBCDIC into a language with which you are more familiar.

1100 1000 ________ 1100 0101 ________ 1101 0011 ________ 1101 0011 ________ 1101 0110 ________

1110 0011 ________ 1101 0110 ________

1110 1000 ________ 1101 0110 ________ 1110 0100 ________

B. Using HO-IV-2 for the necessary code, convert the following line to ASCII-7.

B ________ E ________

H ________ A ________ P ________ P ________ Y ________

C. Using HO-IV-3 for the necessary code, convert the following line of ASCII-8 code into a message.

1010 1011 ________ 1010 0101 ________ 1010 0101 ________ 1011 0000 ________

1011 0011 ________ 1010 1101 ________ 1010 1001 ________ 1010 1100 ________ 1010 1001 ________ 1010 1110 ________ 1010 0111 ________

THE CENTRAL PROCESSING UNIT
UNIT IV

ASSIGNMENT SHEET #4: CONVERTING TO BASE 10

Directions: Using the given transparency master number as a guide, convert to or from base 10 the problems in each of the following sections.

A. Using TM-IV-24 as a guide, convert each of the following problems from binary numbers to decimal numbers.

1. 10110_2 is equal to __________$_{10}$
2. 10110011_2 is equal to __________$_{10}$

B. Using TM-IV-24 as a guide, convert each of the following problems from octal numbers to decimal numbers.

1. 257_8 is equal to __________$_{10}$
2. 246_8 is equal to __________$_{10}$

C. Using TM-IV-25 as a guide, convert each of the following problems from hexadecimal numbers to decimal numbers.

1. $2AE_{16}$ is equal to __________ $_{10}$
2. $2B3C_{16}$ is equal to __________$_{10}$

D. Using TM-IV-26 as a guide, convert each of the following problems from decimal numbers (base 10) to the new base desired.

1. 29_{10} is equal to __________$_2$
2. 186_{10} is equal to __________$_2$
3. 163_{10} is equal to __________$_8$
4. 336_{10} is equal to __________$_8$
5. 264_{10} is equal to __________$_{16}$
6. 430_{10} is equal to __________$_{16}$

THE CENTRAL PROCESSING UNIT
UNIT IV

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET #1

A. 1. 56_8 2. 246_8

B. 1. 111101_2 2. 1010011_2

ASSIGNMENT SHEET #2

A. 1. $C5_{16}$ 2. $2AC_{16}$

B. 1. 10110110_2 2. 1010101001_2

ASSIGNMENT SHEET #3

A. HELLO TO YOU

B. 100 0010 100 0101

100 1000 100 0001 101 0000 101 0000 101 1001

C. KEEP SMILING

ASSIGNMENT SHEET #4

A. 1. 22_{10} 2. 179_{10}

B. 1. 175_{10} 2. 166_{10}

C. 1. 686_{10} 2. 11068_{10}

D. 1. 11101_2 2. 10111010_2 3. 243_8 4. 520_8

5. 108_{16} 6. $1AE_{16}$

THE CENTRAL PROCESSING UNIT
UNIT IV

EXAMINATION

1. Match the terms in Column B with the definitions in Column A by placing the correct number in the blank at the left.

Column A

____a. The time required for the computer to perform the instruction

____b. The waiting time between a request for data and the actual data transfer

____c. The time required to bring an instruction into the control unit and decode the instruction

____d. The time required to move data from one location to another location

____e. Controls and supervises the entire computer program

____f. Allows the programmer to use secondary storage to store programs or parts of programs that require more primary storage than is available

____g. A system utilizing more than one CPU in the same system

Column B

1. Access time
2. Control unit
3. Execution time
4. Instruction time
5. Multiprogramming
6. Transfer time
7. Virtual storage

2. For each function listed below, indicate which part of the CPU performs that function. Indicate your answer by number of the part as presented in Column B.

Column A

____a. Directs and controls devices according to a computer program

____b. Holds program

____c. Makes logic comparisons

____d. Calculates

____e. Has registers

____f. Decodes instructions

____g. Shifts numbers

Column B

1. Arithmetic/Logic Unit
2. Control unit
3. Primary storages

3. Distinguish between the two machine cycles: I-time and E-time.

4. The two items listed below can allow a computer to have great flexibility. Define each term according to its contribution to multiple processing.

   a. Channels

   b. Bus

5. Circle the correct type of primary storage.

   a. This type of primary storage has doughnut-shaped iron rings which can be magnetized in different directions to represent bits of data. (1) Magnetic core or (2) Semiconductor

   b. This type of primary storage has faster access times, has more capacity in the same space, and uses printed circuits to move current. (1) Magnetic core or (2) Semiconductor

6. List three types of electromechanical devices which are used for secondary storage media.

   a.

   b.

   c.

7. Match the electronic secondary storage media in Column A with their correct definitions from Column B.

Column A	
____a. Electron Beam Addressed Memory	1. A magnetic bubble is moved electronically to store and access data.
____b. Magnetic Bubble Memory	2. A semiconductor that uses electrons within a metal oxide semiconductor crystal to store data
____c. Charge Coupled Device	3. Electrical circuits control an electron beam that reads from or writes on a metal oxide semiconductor surface.

8. Match the term in Column B with its definition in Column A by writing the correct number in the blank at the left.

	Column A		Column B
____a.	Contents are retained if power or current is turned off.	1.	Destructive reading
____b.	Each character has one unique location with its own address.	2.	Random Access Memory
____c.	Old data are replaced when new data are read into the same location.	3.	Variable-word length
____d.	Stored data can be accessed directly.	4.	Volatile storage

9. One of the following three series accurately depicts the correct hierarchy, from smallest to largest, of computer storage. Indicate which is correct by placing a check mark in the blank of the correct series.

____a. Bit, Byte, Megabyte, Word, Nibble

____b. Word, Byte, Bit, Nibble, Megabyte

____c. Bit, Nibble, Byte, Word, Megabyte

10. Three numbering systems, other than decimal, were presented in the information sheets. Let binary = 1, octal = 2, and hexadecimal = 3. Record the correct number representing a numbering system in the blank to match the following statements. Statements may have more than one correct answer.

____a. Base 8

____b. Base 16

____c. Extreme right position always a value of 1

____d. Uses 1 as the largest digit

____e. Uses letters to represent values

____f. Represents three binary positions

11. Explain the meaning of a memory dump and explain the use of a memory dump.

12. Four internal data codes have been presented. Match the code from Column B with the correct description in Column A. More than one code may apply to the same description.

Column A

____a. A 6-bit code

____b. An 8-bit code

____c. Based on the Hollerith code

____d. Represents 128 characters

____e. Represents 64 characters

____f. Uses hexadecimal notation

____g. Uses zone bits and digit bits

Column B

1. BCDIC
2. EBCDIC
3. ASCII-7
4. ASCII-8

THE CENTRAL PROCESSING UNIT
UNIT IV

ANSWERS TO EXAMINATION

1. a. 3
   b. 1
   c. 4
   d. 6
   e. 2
   f. 7
   g. 5

2. a. 2
   b. 3
   c. 1
   d. 1
   e. 3
   f. 2
   g. 1

3. I-time is the time required to bring an instruction into the control unit and decode the instruction while E-time is the time required for the computer to perform the instruction.

4. Channels - make it possible for the computer to accept input, perform processing, and output information on the same or different programs at the same time.

   Bus - a group of circuits which provide communication paths between elements of a computer system.

5. a. Magnetic core
   b. Semiconductor

6. a. Magnetic tape
   b. Magnetic disk
   c. Magnetic drum

7. a. 3
   b. 1
   c. 2

8. a. 4
   b. 3
   c. 1
   d. 2

9. C is correct.

10. a. 2

    b. 3

    c. 1, 2, 3

    d. 1

    e. 3

    f. 2

11. A printout of the contents of computer memory which is used as a last resort by programmers to locate errors.

12. a. 1

    b. 2, 4

    c. 1, 2

    d. 3

    e. 1

    f. 2, 3, 4

    g. 1, 2, 3, 4

INTRODUCTION TO CONTROL SYSTEMS
UNIT V

UNIT OBJECTIVE

After completing this unit, students should be able to describe a control system and identify different sizes of computer installations with respective operating systems.

SPECIFIC OBJECTIVES

After completing this unit, students should be able to:

1. Match terms associated with control systems with their definitions.
2. Define three basic elements of data processing.
3. Describe basic elements on special purpose/digital computers.
4. List and define two types of stored programs.
5. List two types of computer instructions.
6. Distinguish between single programming operations and multiprogramming operations.
7. Perform normal computer operations as outlined in operator's manual.
8. Create, maintain, and delete user files.

INTRODUCTION TO CONTROL SYSTEMS
UNIT V

SUGGESTED ACTIVITIES

I. Instructor

  A. Make transparencies.

  B. Provide students with objectives and discuss.

  C. Provide students with information sheets and discuss.

  D. Give examination.

II. Student

  A. Read objectives.

  B. Study information sheets as presented and assigned by instructor.

  C. Complete assignment and job sheets.

  D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit Content

  A. Objectives

  B. Notes to the instructor

  C. Information sheets

  D. Transparency masters

    1. TM-V-1: Elements Common To All Computers

    2. TM-V-2: Special Purpose Computers

    3. TM-V-3: A Computer System

    4. TM-V-4: Common Elements

    5. TM-V-5: Common Elements Plus Auxiliary Storage

    6. TM-V-6: Common Elements Plus Control Program

    7. TM-V-7: Multiprogramming

E. Assignment sheet
   1. AS-V-1: Control Language Commands
F. Answer to assignment sheet
G. Job sheet
   1. JS-V-1: Control Systems Operations
H. Examination
I. Answers to examination

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INTRODUCTION TO CONTROL SYSTEMS
UNIT V

NOTES TO THE INSTRUCTOR

1. You will need to prepare a program, a data file on an external medium, and documentation to be used by the students in completing the job sheet activities.
2. The job sheet is in general terms and must be modified with specific file and job names. Material in brackets ([]) indicates names that must be supplied by the instructor after #1 above has been completed.
3. You will need to guide the students in the use of the operator's manual for the particular computer system.
4. Refer to #8 on the job sheet. This job to be used should be a job that will produce a hard copy.
5. Refer to #13 on the job sheet. Data should be available when loading the input medium so that future steps can be completed.

INTRODUCTION TO CONTROL SYSTEMS
UNIT V

INFORMATION SHEET

I. Terms and Definitions

A. Application programs - programs stored on disks, tapes, etc., and called into main storage when needed. Each program is a sequence of precise instructions to the computer telling it where to get input, how to process it, and where to put the results. (payroll, accounts receivable, etc.)

B. Operating system - the master program that controls the operation of the computer. It must be loaded into the computer's main storage before any processing can take place. The operating system controls the movement of data through a computer system as the system carries out the instructions specified in an application program.

C. Input/Output Control Systems (IOCS) - an interrelated group of programs which pick up and interpret instructions and then initiate and control the necessary transfer of data to or from main storage.

D. Operating systems acronyms

1. DOS/VS (Disk Operating System/Virtual Storage)

2. OS/VS1 (Operating System/Virtual Storage 1)

3. OS/VS2 (Operating System/Virtual Storage 2)

(NOTE: These are various disk-resident comprehensive collections of programs designed to make full use of the resources of the various models of the IBM System/370.)

II. Three Basic Elements of Data Processing (Refer to TM-V-1.)

A. Input - data provided to the system for processing

B. Process - actual counting, adding, subtracting, multiplying, dividing, and manipulating of input data

C. Output - desired results in a usable form, i.e., manual report

III. Special Purpose Computers/Basic Elements (Refer to TM-V-2.)

A. Washing machine

  1. Input - dirty clothes; detergent; water
  2. Process and control - turn on; set appropriate dials for machine control; shut lid
  3. Output - clean clothes

B. The Atari game

  1. Input - puck and 2 players on screen
  2. Process and control - movement of controls by players
  3. Output - increment score by 1

C. Data processing concepts/digital computer (Refer to TM-V-3.)

  1. Input - data entry (Refer to TM-V-4.)
  2. Storage - computer files; programs (Refer to TM-V-5.)
  3. Process - precise instructions and calculations performed on input data as instructed by the application program
  4. Control - movement of data through a computer system
  5. Output - desired results sent to an output device

IV. Two Types of Stored Programs

A. Application programs - See Definitions, I., in this unit. (Refer to AS-V-1 and JS-V-1.)

B. Operating systems - See Definitions, I., in this unit.

  1. Initial Program Load (IPL) - first step in starting a computer. Basic module of operating system is brought from auxiliary storage to main storage.
  2. Stored in auxiliary storage and called into main storage when the computer is to start processing
  3. To save space, some functions of the operating system stay in auxiliary storage and are only called into main storage when needed.
  4. All communications between operator and computer are handled by the operating system.

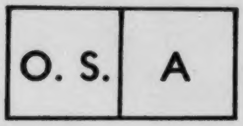
V. Types of Instructions

A. Privileged - instructions that can only be executed by the operating system, i.e., read disk or print a line

B. Nonprivileged - instructions that can be executed by the operating system or the application program

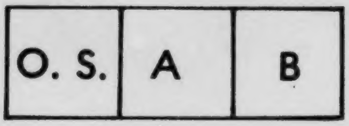
VI. Program Operations

A. Single programming operations (Refer to TM-V-6.)



1. Operator tells operating system which application program to run.
2. Operating system brings application program into main storage and turns control over to application program.
3. Application program starts executing instructions in sequence until it comes to a privileged instruction.
4. Control goes to operating system to execute privileged instruction.
5. After execution of privileged instruction, operating system returns control to application program.

B. Multiprogramming Operations (Refer to TM-V-7.)



1. Application Program A executes until it encounters a privileged instruction, at which time control transfers to the operating system.
2. OS starts the privileged instruction, i.e., find data in auxiliary storage. The processor is idle while waiting for data.
3. OS starts Program B while A is waiting for data. B executes until B encounters a privileged instruction, at which time the OS assumes control, executes the instruction, and returns control to A.

4. With multiprogramming, main storage can be shared by more than one application program with optional priority between optional applications.

   (NOTE: In summation, an operating system or control program is actually an organized collection of programs whose prime objective is to maximize the performance of a data processing system and increase the ease with which the system can be used. The operating system program or control program must reside and operate in main memory at all times to perform required functions. Larger and more complex systems require more sophisticated control programs - see VII.,A., below.)

VII. Operating Systems

A. Large computer environment - main frame

1. Environment - large corporations and businesses, i.e., AT&T, Monsanto, McDonnell Douglas, etc. (Multiple office network across the country)

2. Hardware - $250,000 to $10,000,000

   a. Number of terminals - 50 and up

   b. Size of main memory - 2,000K to 32,000K (NOTE: 1 meg equals 1,000K)

   c. Disk/tape - 4,000 meg to 32,000 meg

   d. Printer speed - multiple printers (1,200 lpm to 20,000 lpm laser or 5 pages per second)

3. Operating system - multiple control programs, usually retrieved from disk storage as needed. The terminal operator has access to several different operating systems depending on job requirements.

4. System programs (See I.,D., in this unit.)

   a. DOS/VS (Disk Operating System/Virtual Storage)

   b. OS/VS1 (Operating System/Virtual Storage 1)

   c. OS/VS2 (Operating System/Virtual Storage 2)

B. Small/moderate computer environment

1. Environment - small to moderate size businesses, up to approximately $20,000,000 sales/year

2. Hardware - $20,000 to $250,000

    a. Number of terminals - 1 to 50

    b. Size of main memory - 32K to 2,000K

    c. Disk/diskette capabilities - 1 meg to 4,000 meg

    d. Printer speed - 50 lpm to 1,200 lpm

3. Operating system - more complex and extensive due to multiple terminals, printers, and size. Operating system usually resides on a hard disk and is called into main memory with the initial program load. The control program size ranges from 24K to 500K.

4. System programs

    a. CPF - Control Program Facility - IBM System 38

    b. SSP - System Support Program - IBM System 34

    c. MCP - Master Control Program - Burroughs-B-80, B-800

C. Micro- or minicomputer environment

1. Environment - home or small businesses, up to approximately $1,000,000 sales/year

2. Hardware - $200 to $20,000

    a. Number of terminals - 1 or more

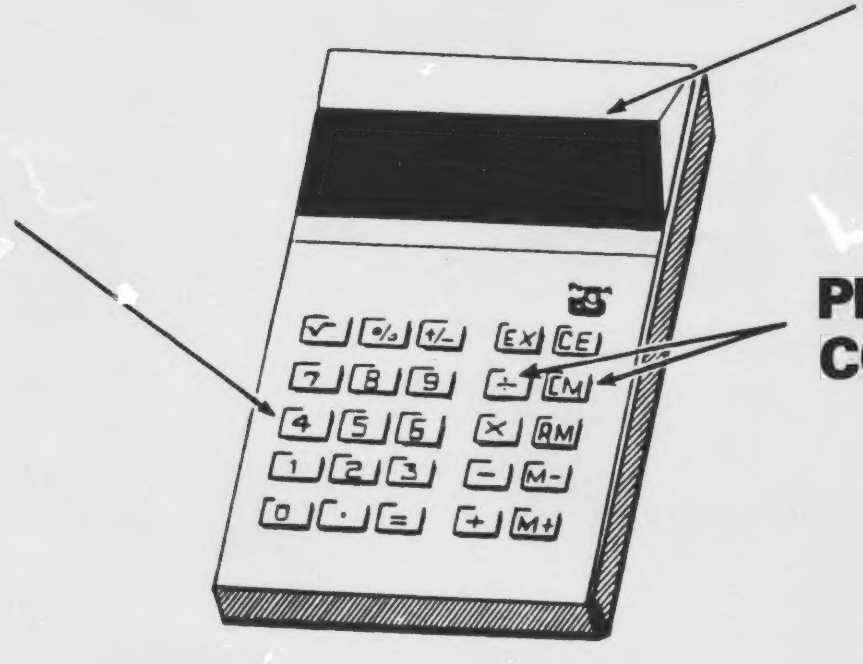
    b. Size of main memory - 1K to 128K

    c. Disk/diskette/tape storage - 90K to 4,800K

    d. Printer speed - 40 cps to 120 cps

3. Operating System - Usually hardwired on a computer chip, i.e., ROM or small operating system due to hardware size and firmware complexity.

Elements Common To All Computers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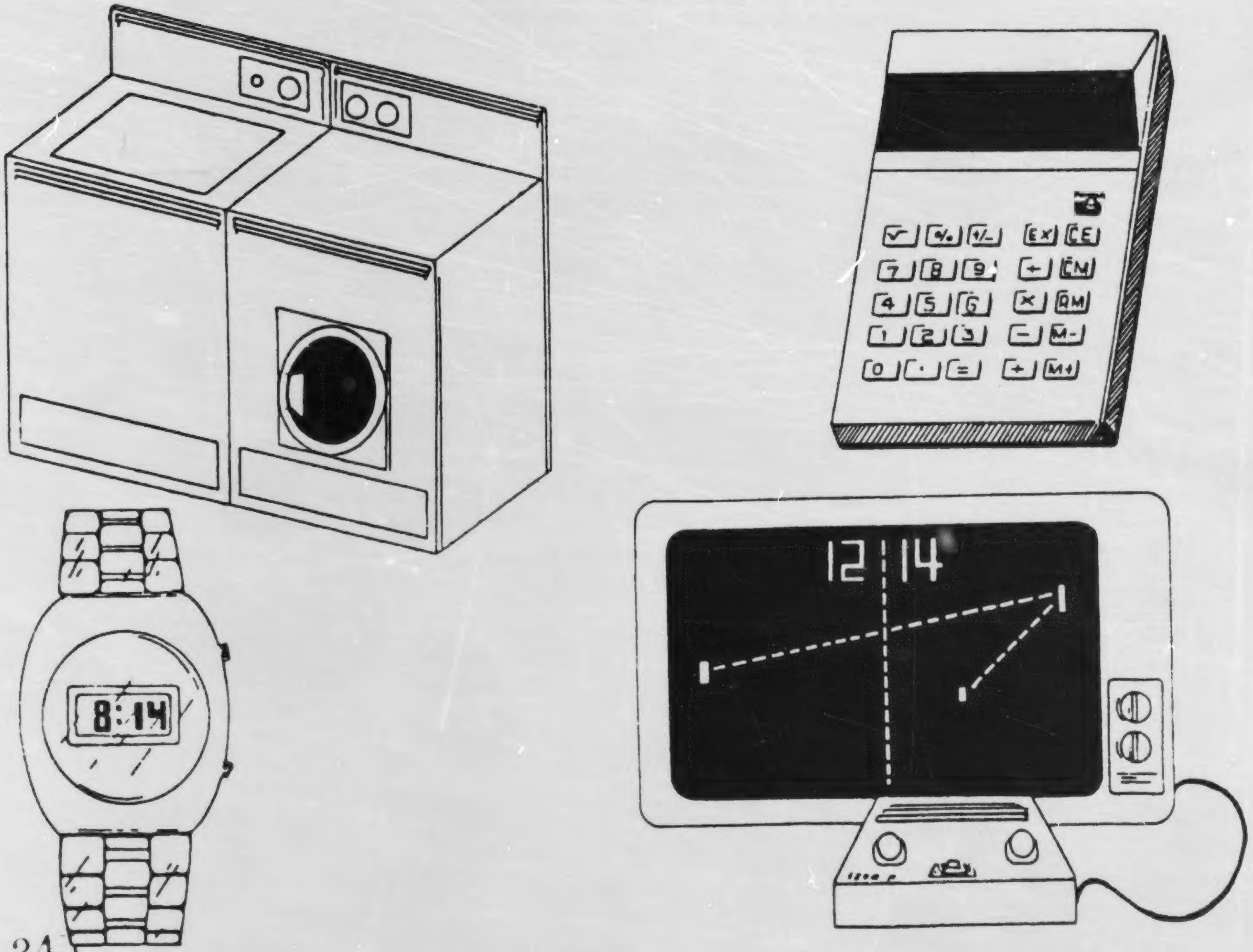
OUTPUT

INPUT

PROCESS and CONTROL

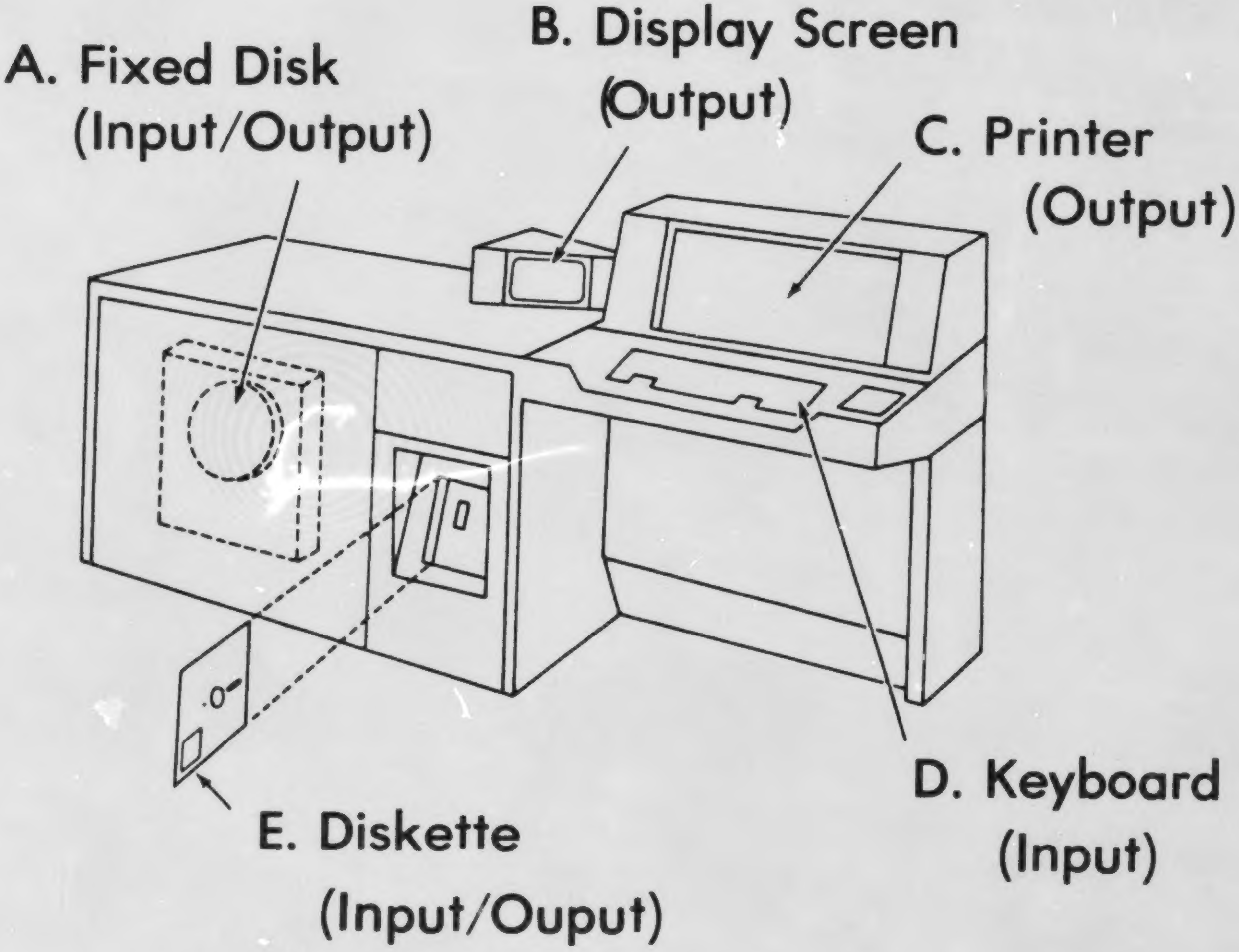
Special Purpose Computers



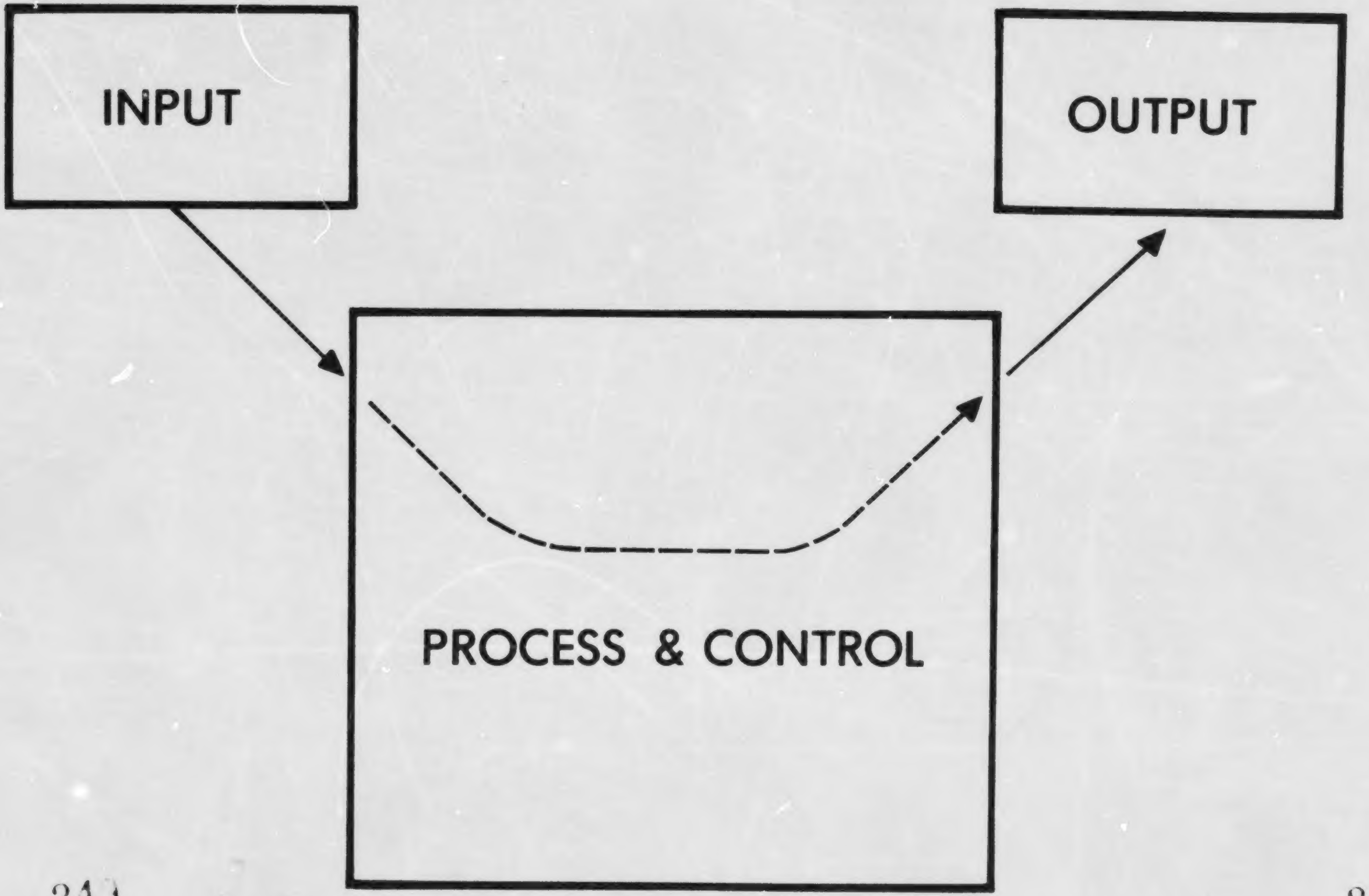
√ %. +/- EX CE
7 8 9 ÷ CM
4 5 6 × RM
1 2 3 − M-
0 . = + M+
8:14
12 14

TM-V-2

A Computer System

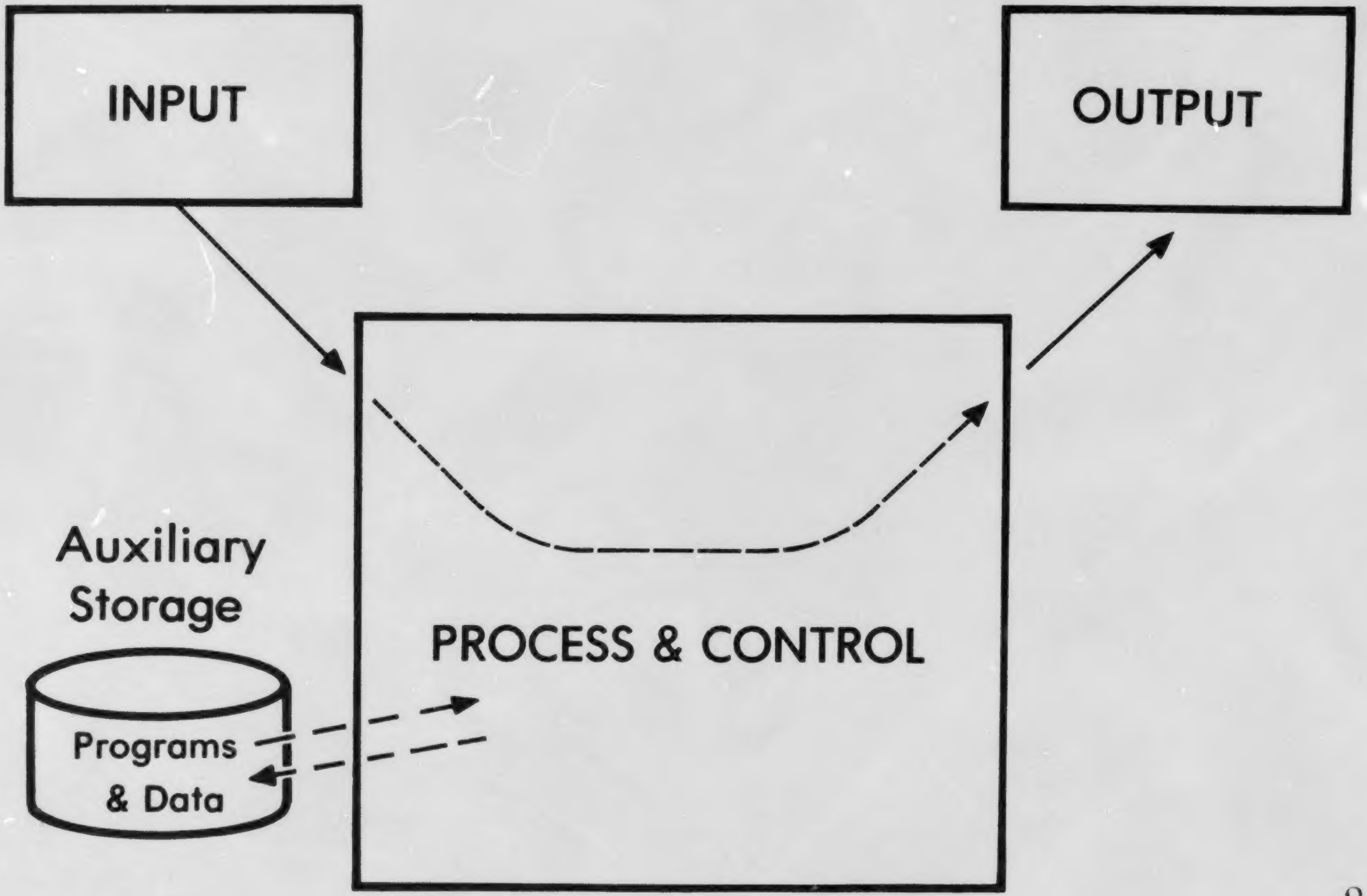

A. Fixed Disk
(Input/Output)
B. Display Screen
(Output)
C. Printer
(Output)
D. Keyboard
(Input)
E. Diskette
(Input/Ouput)

Common Elements


INPUT
OUTPUT
PROCESS & CONTROL

TM-V-4

Common Elements Plus Auxiliary Storage



INPUT

OUTPUT

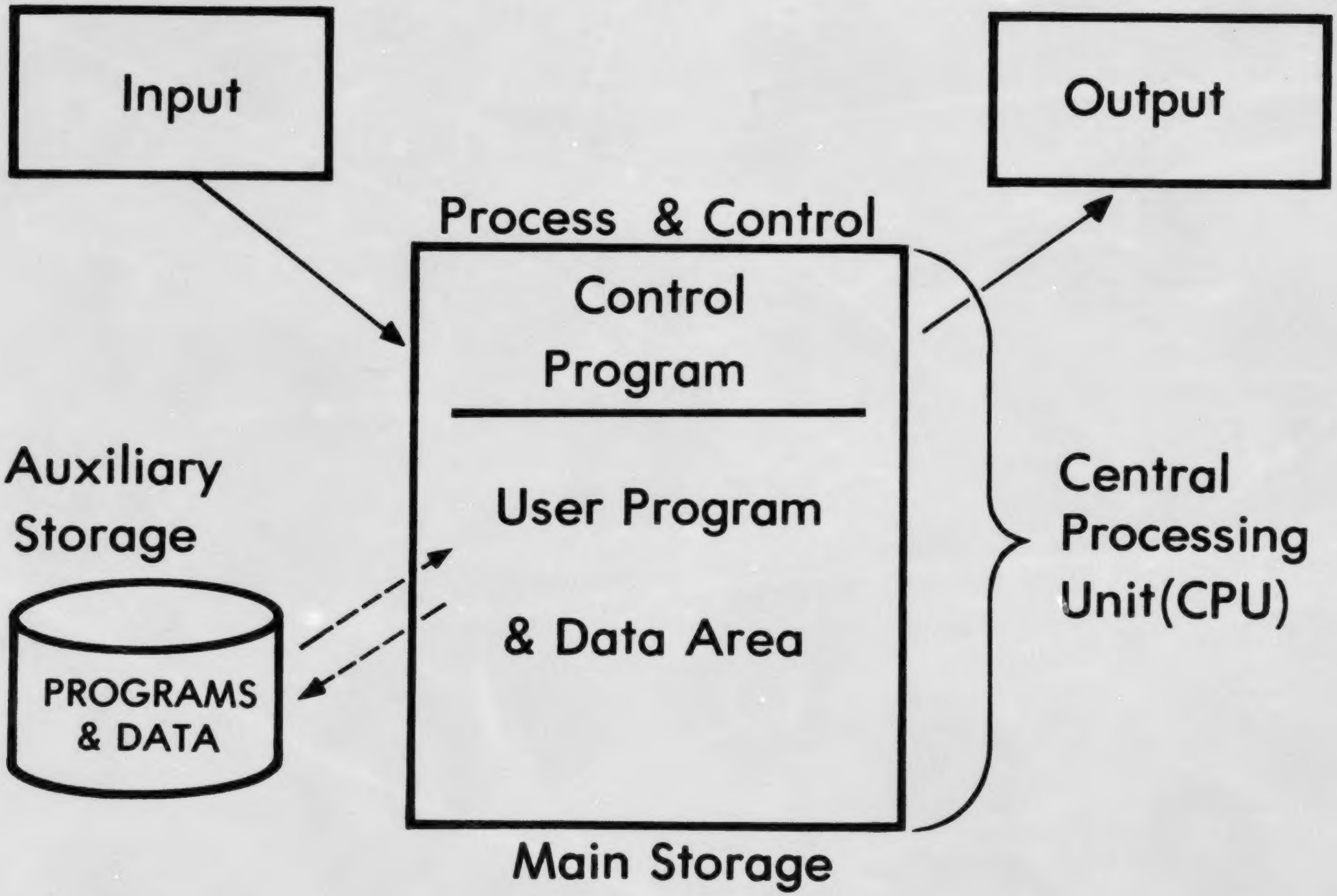
Auxiliary Storage

Programs & Data

PROCESS & CONTROL

TM-V-5

Common Elements Plus Control Program



Input

Output

Process & Control

Control Program

User Program

& Data Area

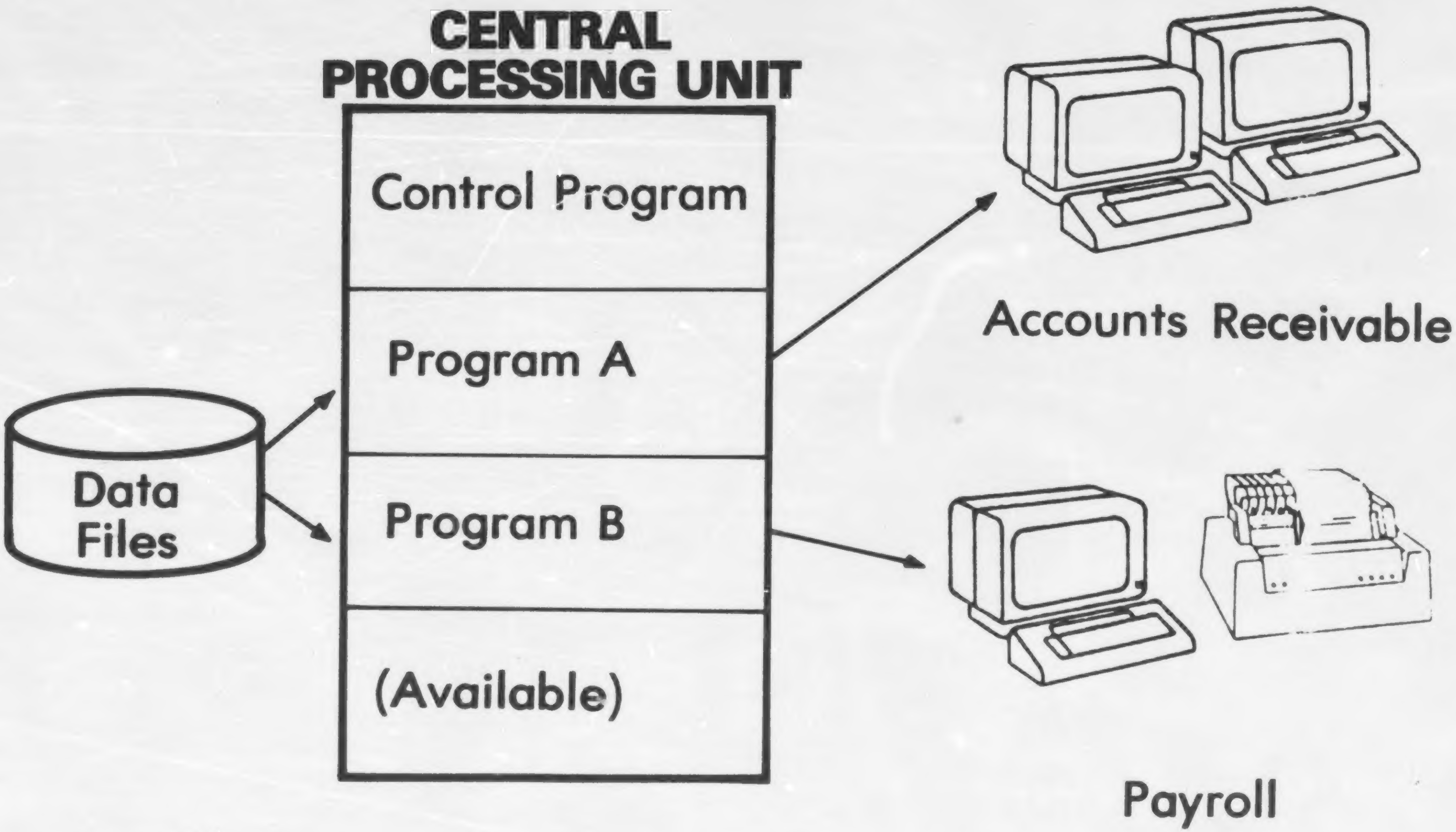
Main Storage

Auxiliary Storage

PROGRAMS & DATA

Central Processing Unit(CPU)

Multiprogramming



CENTRAL PROCESSING UNIT

Control Program

Program A

Program B

(Available)

Data Files

Accounts Receivable

Payroll

TM-V-7

INTRODUCTION TO CONTROL SYSTEMS
UNIT V

ASSIGNMENT SHEET #1: CONTROL LANGUAGE COMMANDS

Directions: Using the control language of your particular computer system, record the operator commands to perform the following operations:

1. Initial Program Load (IPL) from disk. ______________________
2. Cancel [a job] that is being printed. ______________________
3. Cancel [a job] that is being executed. ______________________
4. Initiate [a job]. ______________________
5. Resume [job] execution after a Halt/Interrupt has occurred. ______________________
6. Print the Disk VTOC. ______________________
7. Delete [a disk file]. ______________________
8. Backup [a disk file] on an alternate medium. ______________________
9. List the references you used to complete the above assignment.

INTRODUCTION TO CONTROL SYSTEMS
UNIT V

ANSWER TO THE ASSIGNMENT SHEET

ASSIGNMENT SHEET #1:

Operator commands will vary depending upon the computer system. Rely heavily on your operator's manual.

INTRODUCTION TO CONTROL SYSTEMS
UNIT V

JOB SHEET #1: CONTROL SYSTEMS OPERATIONS

I. Equipment

   A. Computer

   B. Floppy Disk

II. Procedure

   Directions: Keep your operator's log current as you perform the following jobs on a computer system.

   A. Perform the Initial Program Load (IPL).

   B. Respond to a system request.

   C. Initiate [a job].

   D. Interrupt [the job].

   E. Resume [the job] execution.

   F. Cancel [the job].

   G. Change the printer forms and ribbon. (If the ribbon does not need to be changed, refer to the proper manual to be aware of proper procedure.)

   H. Initiate [a job]. (Note: This should be a job that produces a hard copy.)

   I. Halt printing of [job] from H.

   J. Cancel printing of [job] from H.

   K. Initiate [job] from H again.

   L. Distribute the printed report to the appropriate personnel.

   M. Load input medium. (Note: This should contain data for Step N.)

   N. Create [a disk file] from M.

   O. Backup [the disk file] on an external medium.

   P. Label and store the backup file.

   Q. Delete [the disk file] from N.

   R. Print the Disk VTOC.

INTRODUCTION TO CONTROL SYSTEMS
UNIT V

EXAMINATION

1. Fill in the blank with the proper term.
   - a. The master program that controls the operation of the computer is ____________________.
   - b. A group of programs which interprets instructions and initiates and controls the transfer of data to or from main storage is called ____________________________.
   - c. Payroll and Accounts Receivable are examples of ________________ programs.

2. What are the three basic elements of Data Processing?

   a.

   b.

   c.

3. When dealing with a digital computer, there are two concepts other than the three basic elements of data processing. They are:
   - a. _____________ - for programs and files
   - b. _____________ - the orderly movement of data through the system

4. List and define the types of stored programs:

   a.

   b.

5. Why do some functions of the operating system remain in auxiliary storage after the initial program load?

6. All communications between the operator and the computer are handled by _________________________.

7. Name two types of computer instructions.

   a.

   b.

8. What is meant by a single program operation?

9. When an application program comes to a privileged instruction, what happens?

10. Give an example of a privileged instruction.

11. With multiprogramming, main storage can be ____________________

    ____________________________________.

12. In a multiprogramming environment, the operating system executes instructions from two or more programs in main memory at the same time. (Circle one of the following.)

    True or False

13. What is the prime objective of an operating system?

14. A large computer system can have several operating systems that an operator could access. (Circle one of the following.)

    True or False

15. Fill in the blanks with the appropriate configuration of the environment.

    a. Large Computer Environment

       1. Dollar Investment ____________________

       2. Terminals ____________________

       3. Main Memory ____________________

       4. Disk ____________________

    5. Printers ______________________________

b. Small/Moderate Environment

    1. Dollar Investment ______________________________
    2. Terminals ______________________________
    3. Main Memory ______________________________
    4. Disk ______________________________
    5. Printers ______________________________

c. Micro/Mini Environment

    1. Dollar Investment ______________________________
    2. Terminals ______________________________
    3. Main Memory ______________________________
    4. Disk ______________________________
    5. Printers ______________________________

16. Match the following operating systems with their appropriate environment.

a. Large b. Small/Moderate c. Micro/Mini

_____ System Support Program

_____ Disk Operating System/Virtual Storage

_____ Master Control Program

_____ Read Only Memory

_____ Operating System/Virtual Storage 1

INTRODUCTION TO CONTROL SYSTEMS
UNIT V

ANSWERS TO EXAMINATION

1. a. the operating system
   b. input/output control system
   c. application

2. a. Input
   b. Process
   c. Output

3. a. Storage
   b. Control

4. a. Application programs - programs stored on disks, tapes, etc., and called into main storage when needed. Each program is a sequence of precise instructions to the computer telling it where to get input, how to process it, and where to put the results.
   b. Operating system program - the master program that controls the operation of the computer. It controls the movement of data through a computer system as the system carries out the instructions specified in an application program.

5. To save space in main memory

6. the operating system

7. a. Privileged
   b. Nonprivileged

8. Only one application program executes in main memory at a given time.

9. Control transfers to operating system for execution.

10. Read data from disk or print a line.

11. Shared by more than one application program.

12. False (Both reside in main memory at the same time but only one instruction at a time can be executed.)

13. Maximize the performance and increase the ease of use of a computer.

14. True

15. a. 1. $250,000 to $10,000,000
       2. 50 and up

263

3. 2,000K to 32,000K
4. 4,000 meg to 32,000 meg
5. 1,200 lpm to 20,000 lpm

b. 1. $20,000 to $250,000
2. 1 to 50
3. 32K to 2,000K
4. 1 meg to 4,000 meg
5. 50 lpm to 1,200 lpm

c. 1. $200 to $20,000
2. 1 or more
3. 1K to 128K
4. 90K to 4,800K
5. 40 cps to 120 cps

16. b
a
b
c
a

264

PROGRAM PLANNING
UNIT VI

UNIT OBJECTIVE

After studying this unit, students should be aware of the need for program planning, be able to use three methods of program planning, and be able to follow the steps in problem solving.

SPECIFIC OBJECTIVES

After studying this unit, students should be able to:

1. Match terms with definitions of words associated with program planning.
2. Explain why a computer needs a program.
3. Itemize three reasons for program planning.
4. Match flowchart symbols and their meanings.
5. Identify the six sections of a decision table.
6. Explain the three basic logic structures of pseudocode.
7. Identify and explain the five steps in problem solving.
8. Distinguish between syntax errors and logic errors.

PROGRAM PLANNING
UNIT VI

SUGGESTED ACTIVITIES

I. Instructor

  A. Make transparencies.

  B. Provide students with objectives and discuss.

  C. Provide students with information and assignment sheets and discuss.

  D. Provide supplementary information and assignments.

  E. Give examination.

II. Student

  A. Read objectives.

  B. Study information sheets as presented and assigned by instructor.

  C. Complete assignment sheets and supplementary assignments.

  D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit Content

  A. Objectives

  B. Notes to the instructor

  C. Information sheets

  D. Transparency masters

    1. TM-VI-1: A Flowchart Template

    2. TM-VI-2: Symbols for Applications Flowcharts

    3. TM-VI-3: Flowcharted Steps to Getting Up

    4. TM-VI-4: Decision Tables

    5. TM-VI-5: Sections of a Decision Table

6. TM-VI-6: Developing a Decision Table

7. TM-VI-7: Decision Table Example: Payment on Invoice

8. TM-VI-8: Decision Table Format (Sample Form)

9. TM-VI-9: Flowchart and Pseudocode Compared 1

10. TM-VI-10: Flowchart and Pseudocode Compared 2

11. TM-VI-11: Pseudocode Example

12. TM-VI-12: Problem Definition

13. TM-VI-13: Testing and Debugging

E. Assignment sheets

1. AS-VI-1: Completing a Flowchart

2. AS-VI-2: Using a Decision Table

3. AS-VI-3: Constructing a Program Flowchart

4. AS-VI-4: Constructing a Decision Table

5. AS-VI-5: Using Pseudocode

F. Answers to assignment sheets

G. Examination

H. Answers to examination

II. References

A. Brabb, George J., and McKean, Gerald W. Business Data Processing. Boston, MA: Houghton Mifflin Co., 1982.

B. Feingold, Carl. Introduction to Data Processing. 3rd ed., Dubuque, IA: William C. Brown, Co., 1980.

C. Gore, Marvin R., and Stubbe, John W. Computers and Data Processing. New York: McGraw-Hill, Inc., 1979.

D. Stair, Ralph M., Jr. Principles of Data Processing. Homewood, IL: Richard D. Irwin, Inc., 1981.

PROGRAM PLANNING

NOTES TO THE INSTRUCTOR

Transparencies 1 and 2: Stress that the flowchart template has symbols for applications flowcharting and system flowcharting. At this point, students need to be concerned only with those symbols related to the applications flowchart.

Transparency 3: Stress that much thought may need to be given to the steps involved in any problem to be solved. Sometimes decision and processes become so automatic that all possibilities and actions are not explored.

Transparencies 4-8: Emphasize that a decision table might replace a flowchart or might be used to solve a problem in a section of a flowchart. Also, several decision tables may be necessary to plan a successful solution to a problem.

Transparency 8: This transparency has been provided to use in class to work through a decision table with the students.

Transparencies 9-11: Stress that pseudocode is still another way to plan the solution to a problem.

PROGRAM PLANNING
UNIT VI

INFORMATION SHEET

I. Terms and Definitions

A. Assembler - a translate program which converts one language instruction into one machine instruction

B. Bugs - errors in a program which cause it not to run correctly

C. Compiler - a translate program which converts one language instruction into many machine instructions

D. Connector symbol - a flowchart symbol which connects parts of involved flowcharts when flowlines are impractical

E. Decision symbol - a flowchart symbol which shows where a test for a specific condition is made

F. Decision table - a table consisting of six sections which is used for program planning

G. Documentation - an assortment of material which provides information about the problem and the program written to solve the problem

H. DO-UNTIL - a looping logic statement used in pseudocode to continue looping until a condition becomes true

I. DO-WHILE - a looping logic statement used in pseudocode to continue looping as long as a condition is true

J. Flowchart - a pictorial form using standardized symbols to illustrate program logic

K. Flowlines - lines connecting flowcharting symbols to show sequence

L. Housekeeping (Initialization) - setting beginning field names equal to zero or other chosen value

M. IF-THEN - a decision logic statement used in pseudocode to decide if a process should be done or not

N. IF-THEN-ELSE - a decision logic statement used in pseudocode to decide which process to do

O. Input/output symbol - a flowchart symbol which indicates when to input data and when output is desired in a flowchart

P. Interpreter - a program which translates each language instruction as the program runs

Q. Loop - repeated logic used by more than one set of data

R. Object program - a solution of a problem written in machine readable code

S. Off-page connector - a flowchart symbol which continues a flowchart to a new page

T. Preparation symbol - a flowchart symbol which assigns a value to a field when flowcharting

U. Process symbol - a flowchart symbol which indicates where computations are needed in a flowchart

V. Pseudocode (PDL) - an imitation of actual computer instructions used for program planning

W. Source program - the solution of a problem readable by a programmer in a higher level language

X. Syntax - the rules regarding spelling, punctuation, and grammar

Y. Terminal symbol - a flowchart symbol which indicates beginnings, pauses, and endings

Z. Test data - data with known answers to test program accuracy

II. Need to Program

A. Tells the control unit what instructions to follow

B. Tells the computer how to solve a specific problem

III. Need for Program Planning

A. Programmer must be able to solve problem manually before writing a program

B. Ensures that program instructions are appropriate

C. Ensures that steps in program are in correct sequence

D. Helps structure logic correctly in program

E. Documents finished program

1. Documentation assists in making future changes in an existing program.

2. Documentation provides information about what a program can do.

IV. Flowchart - a pictorial or graphic form using standardized symbols to illustrate program logic (Refer to AS-VI-1 and AS-VI-3.)

A. American National Standards Institute (ANSI) developed standard symbols for flowcharting.

B. Plastic or metal guide (template) is used to draw symbols. (Refer to TM-VI-1, TM-VI-2, and TM-VI-3.)

C. Programming related symbols

1. Terminal symbol

   a. Indicates beginning and ending

   b. Indicates pauses, such as to change forms on the printer

2. Input/output symbol

   a. Indicates input into a program

   b. Indicates output to chosen device

3. Flowlines

   a. Lines connecting flowcharting symbols to show sequence

   b. Arrowheads indicate direction of flow.

      1) Normal vertical flow is top to bottom.
      2) Normal horizontal flow is left to right.
      3) Arrowheads are required whenever flow is not normal.

4. Loop

   a. Logic which can be repeated

   b. Flowlines used to indicate repetition

5. Decision symbol

   a. A test for a specific decision

   b. Usually stated as a question with yes or no answer

    c. Can be used to control or end a loop

6. Process symbol

    a. Indicates an action to be taken

    b. Can indicate an arithmetic process

    c. Can indicate moving data from one storage location to another

7. Preparation symbol

    a. An International Organization for Standardization (ISO) symbol

    b. Can use process symbol instead of preparation symbol (not an ANSI standard)

    c. Assigns a value to a field

    d. Used for "Housekeeping" such as making sure a value in the program begins with zero or a chosen value

8. Connector symbol

    a. Can substitute for flowlines

    b. Connector link when two or more connectors contain the same character

    c. Exit connectors leave normal flow

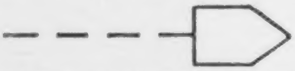
    d. Entry connectors return flow to mainstream

    e. Can never be more than one entry connector containing same character

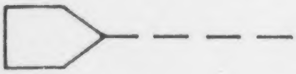
9. Offpage connector

    a. IBM symbol beyond ANSI and ISO standards

    b. Use exit offpage connector to go to a new page



    c. Entry offpage connector shows starting point on a new page



D. Three problems with flowcharting a problem

1. Flowcharting can be time consuming.
2. Flowcharting does not necessarily provide the most efficient solution.
3. Flowcharting can be confusing if long and involved.

V. Decision Table (Refer to AS-VI-2, AS-VI-4, TM-VI-4, TM-VI-5, TM-VI-6, TM-VI-7, and TM-VI-8.)

A. Shows conditions and actions more clearly than flowchart

B. Used to supplement or replace a flowchart

C. Most useful when a problem has many complex logic decisions

D. Divided into six sections set off by double vertical and horizontal lines

1. Upper left, name of decision table
2. Left middle contains conditions of the problem and is called condition stub.
3. Lower left contains possible actions to solve the problem and is called action stub.
4. Rule numbers in upper right
5. Middle right contains yes (Y) or no (N) answers to conditions and is called condition entry.
6. Lower right indicates by "X" the appropriate action to solve the problem based on rules in third section and is called action entry.

E. May need a succession of decision tables to describe the necessary detail to solve the problem

VI. Pseudocode - An Imitation of Actual Computer Instructions. Also Called Program Design Language (PDL) (Refer to AS-VI-5, TM-VI-9, TM-VI-10, and TM-VI-11.)

A. Advantages

1. Structure is easy to convert to programming language.
2. Easy to write and modify

B. Disadvantages

1. Can be difficult for a beginner to follow the logic and write pseudocode

2. Can be time consuming

C. Three basic logic structures

1. Sequence logic - writing pseudocode instructions in the sequence in which they are to be performed

2. Decision logic

a. IF-THEN - Based on conditions, decide if the process should be done or not.

b. IF-THEN-ELSE - If condition is true, do process 1; if condition is false (else), do process 2.

c. END-IF - ends the decision logic

3. Looping logic

a. DO-WHILE

1) Looping continues as long as condition is true.
2) Condition is tested at beginning of loop by a statement.

b. DO-UNTIL

1) Looping continues until a condition becomes true.
2) Condition is tested at end of loop by a statement.

c. END-DO - ends the looping logic

D. EOF - Pseudocode meaning end-of-file

E. Each decision in pseudocode is indented.

F. Each decision ends with END-IF vertically aligned below the corresponding IF statement.

VII. Five Steps in Problem Solving

A. Define the problem. (Refer to TM-VI-12.)

1. What end results are desired?

2. How will the data be manipulated?

3. In what form is the data?

4. What data will be processed?

5. Can the problem be solved?

6. Should the computer solve the problem? Is it productive?

B. Three alternatives to plan the solution

1. Flowchart

2. Decision table

3. Pseudocode

C. Prepare solution for execution.

1. Code the program using the correct coding sheet for the language being written.

2. Desk check for accuracy and correct logic

3. Enter data and program on input media.

D. Execute the solution.

1. As data is inputted, the source program is translated into an object program. (Refer to definitions in this outline.)

    a. Assembler - converts one language instruction to one machine instruction

    b. Compiler

        1) Generates many machine statements from each language statement
        2) Used by COBOL, FORTRAN, RPG (higher level languages)

    c. Interpreter

        1) Translates each language instruction as program is running
        2) BASIC language usually uses an interpreter.

    d. Translator is a program supplied by the computer manufacturer.

    e. Different languages require different translators.

    f. Translators check coding of program (syntax). (Refer to TM VI-13.)

1) Checks for proper spelling
2) Checks for proper punctuation
3) Checks that the language rules are followed

2. Detecting errors (bugs)

a. Coding errors (syntax errors)

1) Instructions written incorrectly
2) Translator indicates error by message on program listing.

b. Logic errors

1) Compare results with desired output.
2) Errors in planning program logic
a) Missing logic
b) Incorrect logic
3) Locate error by studying the logic of the program listing.
4) Examine memory dumps as a last resort.

E. Document the solution.

1. Document as reference all papers, solutions, etc., used in all phases of solving the problem

a. Computer programs

b. Operating procedures

c. Description of the program

d. Files required

e. Hardware required

f. Flowcharts, decision tables, pseudocode, etc.

g. Formulas

h. Explanations

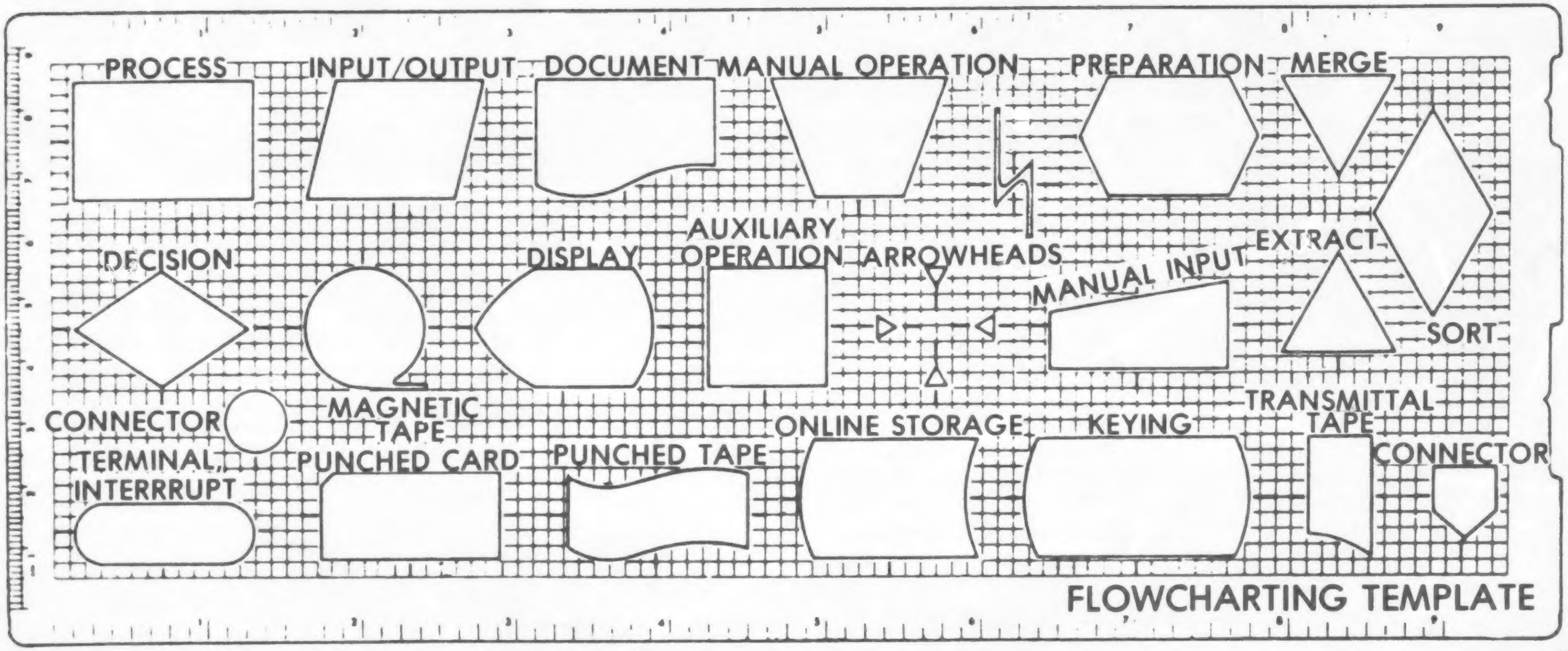
i. Program listing

j. Sample runs

k. Special instructions

2. Check format and procedures for documentation in each different data processing center.

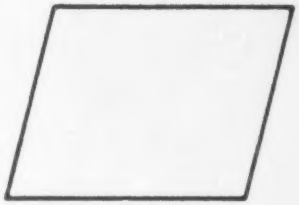
A Flowchart Template


PROCESS
INPUT/OUTPUT
DOCUMENT
MANUAL OPERATION
PREPARATION
MERGE
DECISION
DISPLAY
AUXILIARY OPERATION
ARROWHEADS
MANUAL INPUT
EXTRACT
SORT
CONNECTOR
MAGNETIC TAPE
ONLINE STORAGE
KEYING
TRANSMITTAL TAPE
TERMINAL, INTERRRUPT
PUNCHED CARD
PUNCHED TAPE
CONNECTOR
FLOWCHARTING TEMPLATE

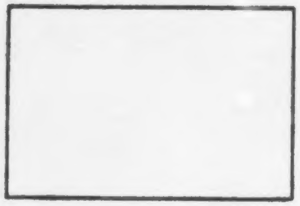
TM-VI-1

Symbols for Applications Flowcharts

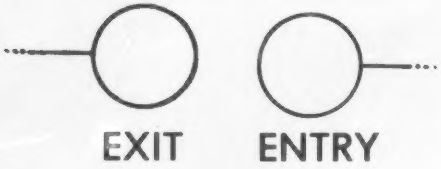
Input/ Output



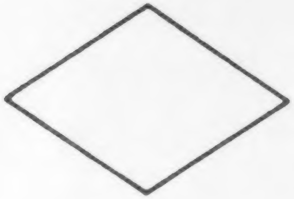
Process



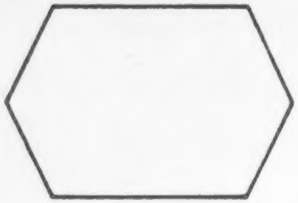
Connectors



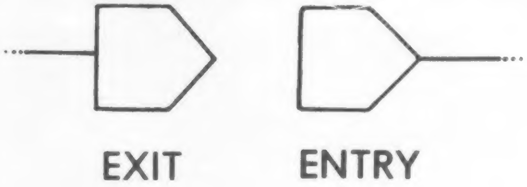
Decision



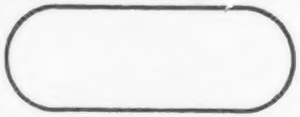
Preparation



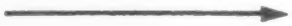
Offpage Connectors



Terminal Interrupt



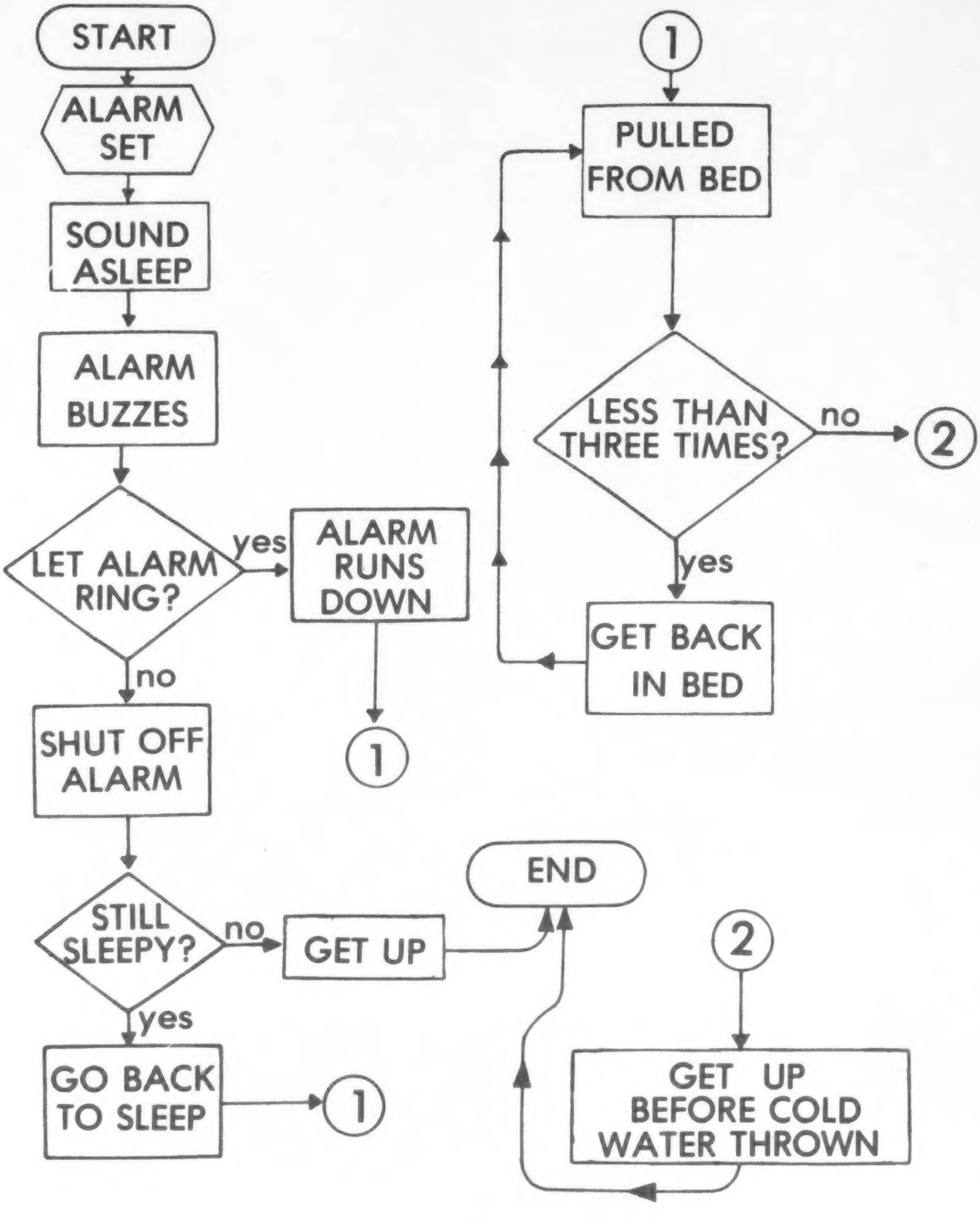
Flowlines



TM-VI-2

TM-VI-3

Flowcharted Steps to Getting Up


START
ALARM SET
SOUND ASLEEP
ALARM BUZZES
LET ALARM RING?
yes
ALARM RUNS DOWN
1
no
SHUT OFF ALARM
STILL SLEEPY?
no
GET UP
END
yes
GO BACK TO SLEEP
1
1
PULLED FROM BED
LESS THAN THREE TIMES?
no
2
yes
GET BACK IN BED
2
GET UP BEFORE COLD WATER THROWN

TM-VI-4

Decision Tables

- Display the different conditions that could exist and the different actions the computer should take as a result of these conditions.

- Useful when there are a large number of different branches within a program or when there are a large number of decisions.

- There are 6 parts to a Decision Table.

Sections of a Decision Table

1 (Name of Decision Table)	4 (Rule Numbers)
2 (Condition Statements)	5 (Actual Conditions)
3 (Action Statements)	6 (Actions Taken)

Developing a Decision Table

Rule	Condition	Action
1	Customer Has A Charge Account And Satisfactory Credit.	Accept Order
2	Customer Has A Charge Account And Unsatisfactory Credit Rating With Special Management Approval For The Purchases.	Accept Order
3	Customer Has A Charge Account And Unsatisfactory Credit Rating With No Special Management Approval For The Purchase.	Reject Order
4	Customer Has No Charge Account With Store.	Reject Order

Placing These Into Our Decision Table, We Have:

DECISION TABLE 1	RULE 1	RULE 2	RULE 3	RULE 4
Customer Has A Charge Account	Y	Y	Y	N
Customer Has A Good Credit Rating	Y	N	N	
Customer Has A Special Management Approval		Y	N	
Accept Order	X	X		
Reject Order			X	X

Decision Table Example: Payment on Invoice

	Rules		
	1	2	3
1. Discount Available	Y	N	
2. Paid within Discount Period	Y		N
CONDITION STUB	**CONDITION ENTRY**		
ACTION STUB	**ACTION ENTRY**		
1. Pay Invoice Less Discount	X		
2. Pay Total Amount of Invoice		X	X

TM-VI-8

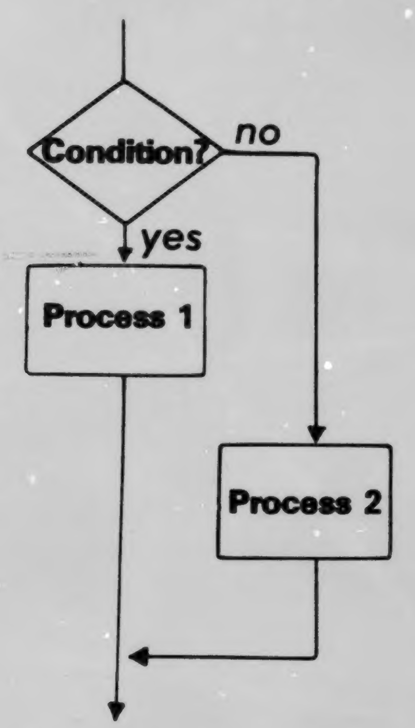
Decision Table Format
(Sample Form)

1.	4.
2.	5.
3.	6.

Flowchart and Pseudocode Compared [1]

IF-THEN-ELSE

Flowchart

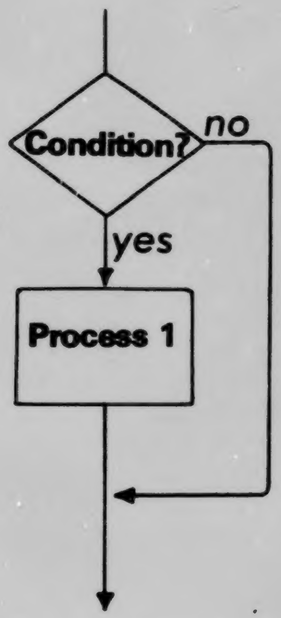

Condition?
no
yes
Process 1
Process 2

Pseudocode

```
•
•
IF condition
    process 1
ELSE
    process 2
END-IF
•
•
•
•
```

IF-THEN

Flowchart


Condition?
no
yes
Process 1

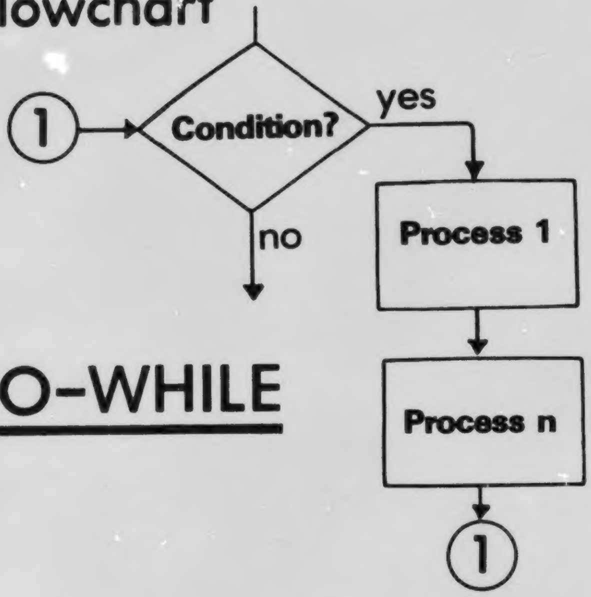
Pseudocode

```
•
•
IF condition
    process 1
END-IF
•
•
•
•
•
```

Flowchart and Pseudocode Compared[2]

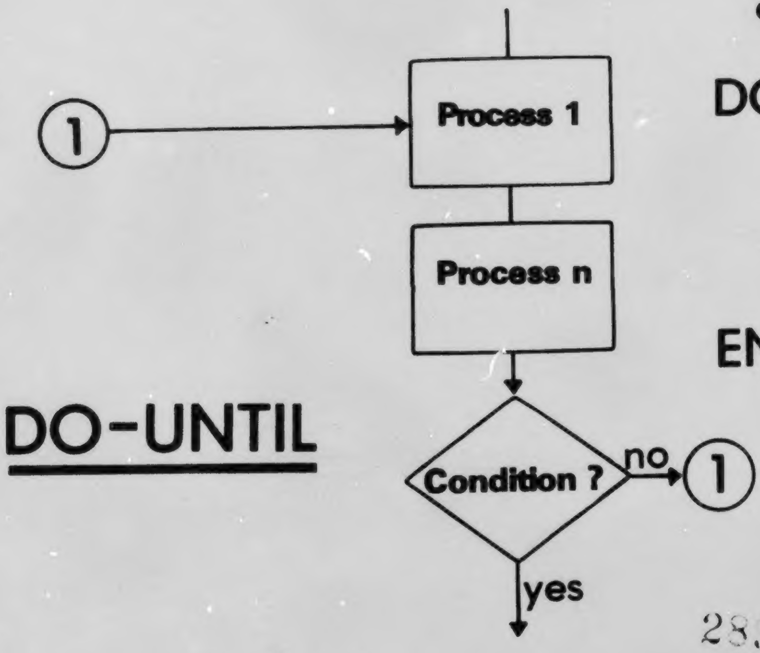
Flowchart

Pseudocode


1
Condition?
yes
no
Process 1
Process n
1

DO-WHILE

```
•
DO-WHILE condition
        process 1
        process n
END-DO
•
•
```


1
Process 1
Process n
Condition ?
no
1
yes

DO-UNTIL

```
•
DO-UNTIL condition
        process 1
        process n
END-DO
```

Pseudocode Example

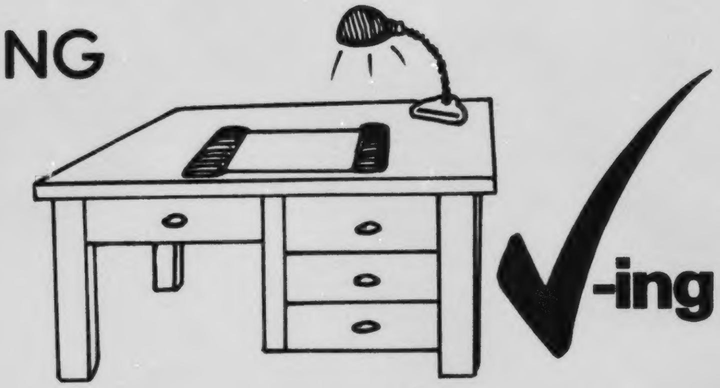
```
more students = yes
read first record
DO-WHILE more students
        add 1 to total students
        add age to total age
        read next record
                EOF sets more students = no
END-DO
calculate average age
print average age
```

```
more students = yes
read first record
DO-WHILE more students
        IF sex = male
                IF age<17
                        IF age>26
                                print the name
                                add 1 to total count
                        END-IF
                END-IF
        END-IF
        read next record
                EOF sets more students = no
END-DO
print total count
```

Problem Definition

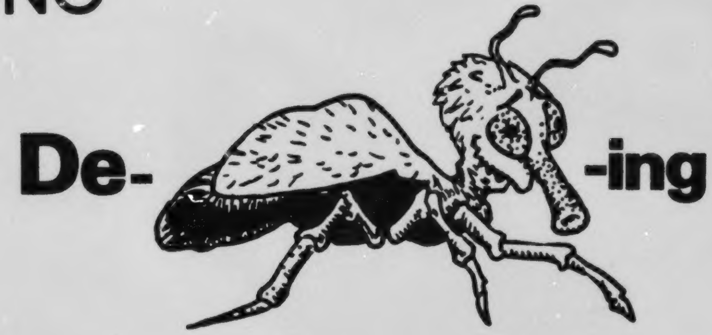
- Determining Desired End Results
- Determining Data Manipulations
- Determining Form Of Input Data
- Determining Input Data Required
- Determining If The Problem Can Be Solved
- Determining If The Problem Is Best Done On Computer

Testing and Debugging



DESK CHECKING

SYSTEM CHECKING



ERRORS

- SYNTAX
- LOGIC

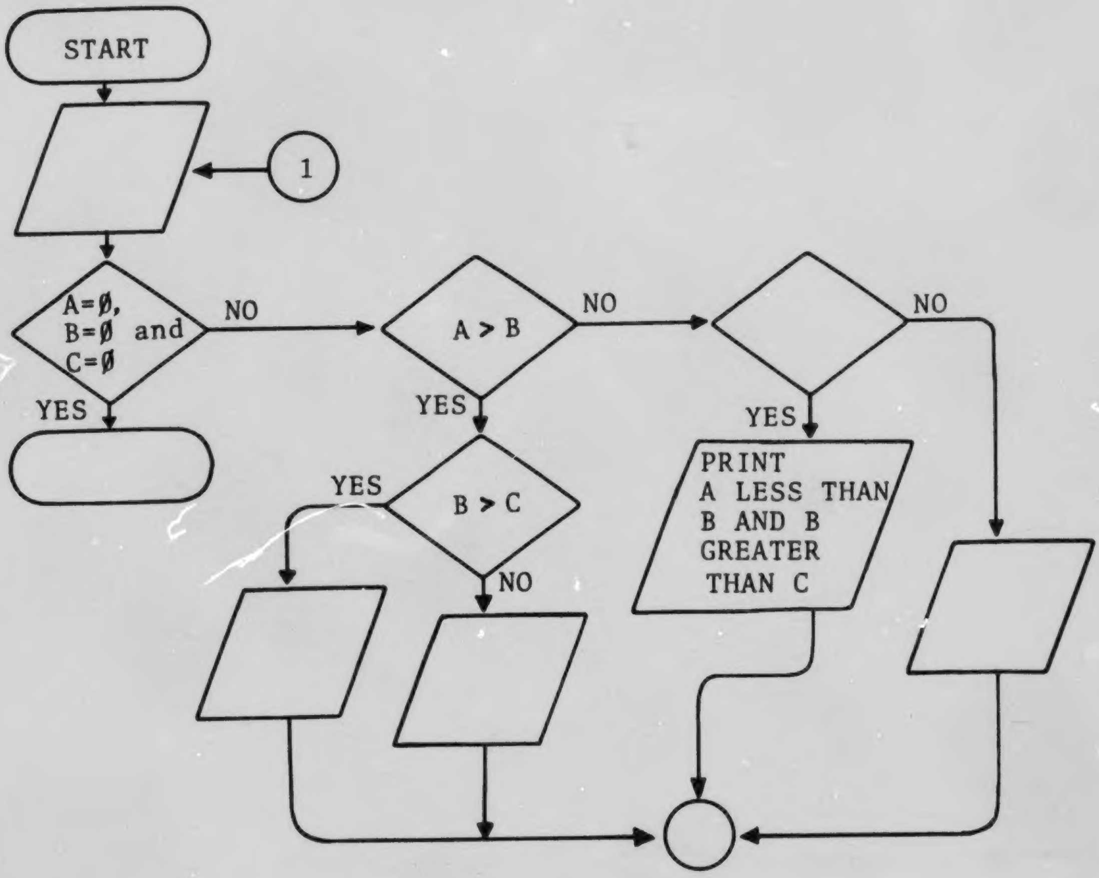
MEMORY DUMPS

PROGRAM PLANNING
UNIT VI

ASSIGNMENT SHEET #1: COMPLETING A FLOWCHART

Directions: Use the following lines to complete the flowcharts below:

B > C
END
PRINT A IS GREATER THAN B AND B IS LESS THAN C
PRINT A IS LESS THAN B AND B IS LESS THAN C
PRINT A IS GREATER THAN B AND B IS GREATER THAN C
READ A,B,C
1


START
1
A=0,
B=0 and
C=0
NO
YES
A > B
NO
YES
NO
YES
B > C
YES
NO
PRINT
A LESS THAN
B AND B
GREATER
THAN C

PROGRAM PLANNING
UNIT VI

ASSIGNMENT SHEET #2: USING A DECISION TABLE

Directions: Mary has constructed a decision table to help her in deciding whether to accept a date or not.

Decision Table Name	Rule	Condition	Action
Accept date	1.	He does not own car	Reject date
	2.	He does own car and spends more than $25 on dates	Accept date
	3.	He does own car and he does not spend less than $10 on dates and he is cute	Accept date
	4.	He spends less than $10 on dates	Reject date

	1	2	3	4
He owns his own car	N	Y	Y	
He is cute			Y	
He spends less than $10 on dates			N	Y
He spends more than $25 on dates		Y		
Accept date		X	X	
Reject date	X			X

Who does Mary accept and reject as dates given the following information:

Jim owns his own car and spends more than $25 on dates; Mark owns his own car, is cute, and spends more than $10 on dates; Stan does not own his own car.

ASSIGNMENT SHEET #3: CONSTRUCTING A PROGRAM FLOWCHART

Directions: Construct a program flowchart to be used in writing a program. The problem is that letter grades need to be determined for each student in class based upon the number of points out of 100 scored on an examination. The total points required for each letter grade are as follows: Score 90 or above receives an "A," score 80-89 receives a "B," score 70-79 receives a "C," score of 60-69 receives a "D," and a score below 60 receives an "F."

ASSIGNMENT SHEET #4: CONSTRUCTING A DECISION TABLE

Directions: Construct a decision table to be used in writing a program. The problem is that letter grades need to be determined for each student in class based upon the number of points out of 100 scored on an examination. The total points required for each letter grade are as follows: Score 90 or above receives an "A," score 80-89 receives a "B," score 70-79 receives a "C," score of 60-69 receives a "D," and a score below 60 receives an "F."

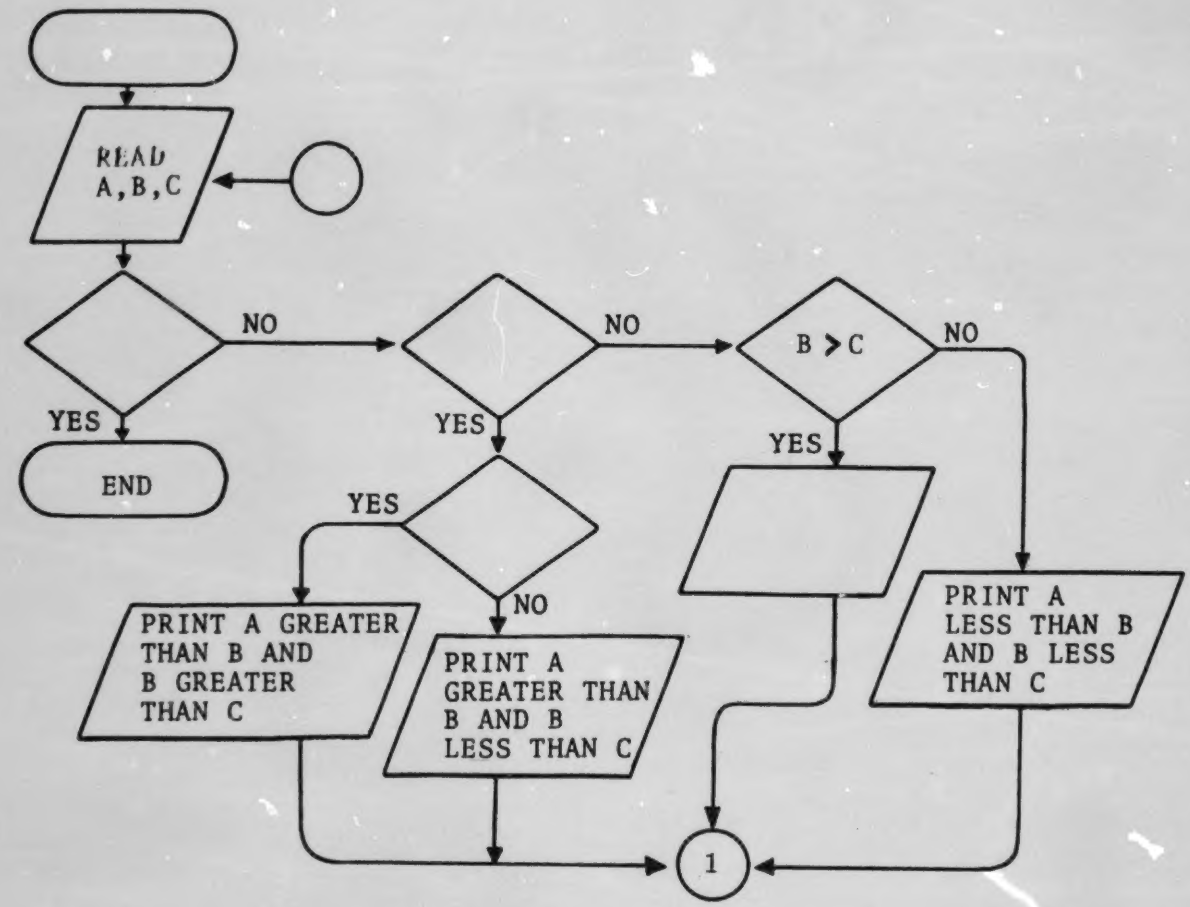
ASSIGNMENT SHEET #5: USING PSEUDOCODE

Directions: Construct a pseudocode solution to be used in writing a program. The problem is that letter grades need to be determined for each student in class based upon the number of points out of 100 scored on an examination. The total points required for each letter grade are as follows: Score 90 or above receives an "A," score 80-89 receives a "B," score 70-79 receives a "C," score of 60-69 receives a "D," and a score below 60 receives an "F."

PROGRAM PLANNING
UNIT VI

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET #1



READ A,B,C
NO
YES
END
NO
YES
YES
NO
B > C
NO
YES
PRINT A GREATER THAN B AND B GREATER THAN C
PRINT A GREATER THAN B AND B LESS THAN C
PRINT A LESS THAN B AND B LESS THAN C
1

ASSIGNMENT SHEET #2

Accept Jim and Mark
Reject Stan

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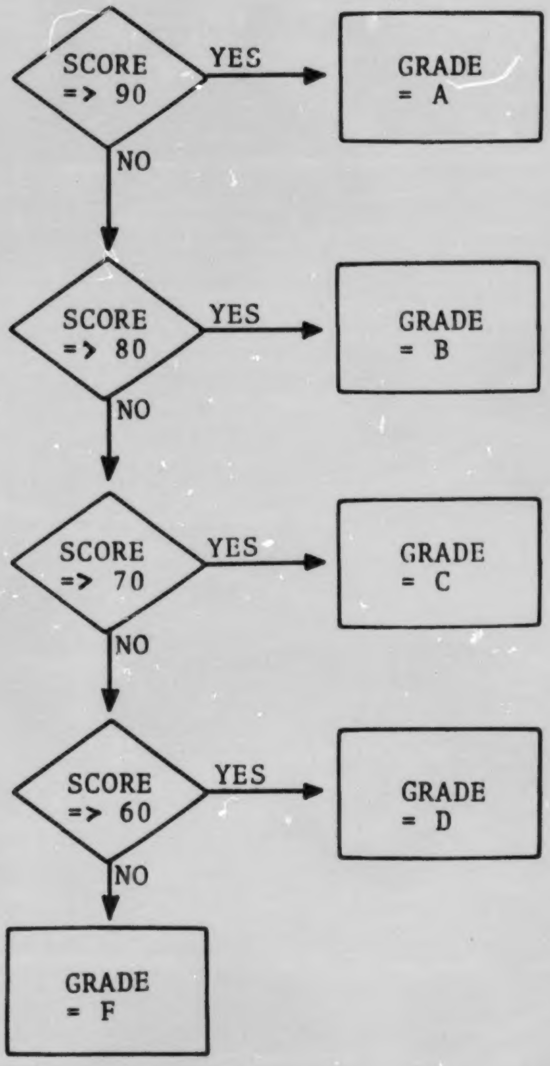
ASSIGNMENT SHEET #3


SCORE => 90
YES
GRADE = A
NO
SCORE => 80
YES
GRADE = B
NO
SCORE => 70
YES
GRADE = C
NO
SCORE => 60
YES
GRADE = D
NO
GRADE = F

ASSIGNMENT SHEET #4

Rule 1 - grade is A if score is equal to or greater than 90
Rule 2 - grade is B if score is less than 90 but equal to or greater than 80
Rule 3 - grade is C if score is less than 80 but equal to or greater than 70
Rule 4 - grade is D if score is less than 70 but equal to or greater than 60
Rule 5 - grade is F if score is less than 60

DECISION TABLE FOR DETERMINING GRADES	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
Score = 90	Yes				
Score = 80	No	Yes			
Score = 70	No	No	Yes		
Score = 60	No	No	No	Yes	
Score =< 60	No	No	No	No	Yes
Grade = A	X				
Grade = B		X			
Grade = C			X		
Grade = D				X	
Grade = F					X

ASSIGNMENT SHEET #5

```
more scores = yes
read score
DO-WHILE more scores
    IF score =   90
    print A
    END-IF
        IF score =   80
        print B
        END-IF
            IF score =   70
            print C
            END-IF
                IF score =   60
                print D
                END-IF
                    IF score =< 60
                    print F
                    END-IF
                        read next score
                            EOF sets more scores =   no
END-DO
```

PROGRAM PLANNING
UNIT VI

EXAMINATION

1. Explain why a computer needs programs if it is to function.

2. List three (3) reasons for program planning.

3. Match each of the flowchart symbols from Column B with the correct meaning of the flowchart symbol in Column A.

Column A			Column B	
_____	a)	Terminal	1.	→
_____	b)	Input/output	2.	○
_____	c)	Flowlines	3.	▭
_____	d)	Decision	4.	⬡
_____	e)	Process	5.	◇
_____	f)	Preparation	6.	⬭
_____	g)	Connector	7.	▱

4. Identify the use of each of the six numbered sections of the sample decision table.

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________

1	4
2	5
3	6

5. Listed below are the three basic logic structures of pseudocode. Explain each section, including the names used in illustrating the logic.

   A. Sequence Logic -

   B. Decision Logic -

   C. Looping Logic -

6. Identify and briefly explain the five steps in problem solving.

   A.

   B.

   C.

   D.

   E.

7. Define:

   A. A syntax error -

   B. A logic error -

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PROGRAM PLANNING
UNIT VI

ANSWERS TO EXAMINATION

1. A computer is dumb without directions. Programs give those directions to the computer.

2. Any of the following:

   Understand the problem.
   Write appropriate program instructions.
   Keep steps in proper sequence.
   Helps structure logic correctly
   Documents completed program

3. a) - 6, b) - 7, c) - 1, d) - 5, e) - 3, f) - 4, g) - 2

4. 1. Name
   2. Condition statements
   3. Action statements
   4. Rule numbers
   5. Actual conditions
   6. Actions taken

5. A. Presents instructions in correct sequence
   B. IF-THEN decides whether or not to do a process based on conditions.
      IF-THEN-ELSE decides which process to do based on conditions.
   C. DO-WHILE continues loop if condition is true.
      DO-UNTIL continues loop until condition becomes true.

6. A. Define the problem - examine the problem, identify the input, design the output
   B. Plan the solution - flowchart, decision table, or pseudocode
   C. Describe the solution - code the program in programming language and check coding
   D. Execute the solution - have the computer run the program and debug the program
   E. Document the solution - file all references to all phases of the problem solving process

7. A. A syntax error is when an instruction is written incorrectly.
   B. A logic error is an error in planning program caused by missing logic or incorrect logic.

BASIC PROGRAMMING
UNIT VII

UNIT OBJECTIVE

After studying this unit, students should be able to discuss some generalities about the BASIC programming language and use correct form and correct statements in solving problems by computer using the BASIC language.

SPECIFIC OBJECTIVES

After studying this unit, students should be able to:

1. Match BASIC programming terms with their definitions.
2. Discuss general features about the BASIC language.
3. Itemize in correct order the three basic requirements in program design.
4. State the operation of the arithmetic hierarchy as it applies to solving arithmetic expressions.
5. Write a correct REM statement.
6. Write a correct INPUT statement.
7. Write correct READ and DATA statements.
8. Explain the function of a RESTORE statement.
9. Write a correct LET statement.
10. Write a correct PRINT statement.
11. Write a correct PRINT literal.
12. Explain the purpose of the END statement.
13. Compare a conditional branch and an unconditional branch.
14. Explain the use of a GOTO statement.
15. Explain how a given IF-THEN statement will function.
16. Given the meaning of IF-THEN relational symbols, supply the correct symbol.
17. Explain how an ON statement causes the computer to function.

18. Write correct FOR-TO and NEXT statements including STEP and explain its operating procedure.

19. Explain how FOR-TO, NEXT, and READ statements function to create a list.

20. Explain the function of the OPTION BASE command.

21. Identify correct indicators for table rows and columns.

22. Explain a given DIM statement in terms of its use in a list and/or table.

23. Match function names and function descriptions.

24. Write a correct statement to select a random integer between 1 and 100.

25. Explain how to cause the computer to enter a subroutine and return to the original program.

26. Explain the use of a DEF statement.

27. Write and successfully execute as many correct BASIC programs as assigned by your instructor.

BASIC PROGRAMMING
UNIT VII

SUGGESTED ACTIVITIES

I. Instructor

   A. Make transparencies.

   B. Provide students with objectives and discuss.

   C. Provide students with information and assignment sheets and discuss.

   D. Provide supplementary information sources.

   E. Assign problems for students to program and run.

   F. Give examination.

II. Student

   A. Read objectives.

   B. Study information sheets as presented and assigned by instructor.

   C. Complete assignment sheets.

   D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit Content

   A. Objectives

   B. Notes to instructor

   C. Information sheets

   D. Transparency masters

      1. TM-VII-1: Three Requirements for Writing a Program

      2. TM-VII-2: The Arithmetic Hierarchy

      3. TM-VII-3: BASIC Statements^1

      4. TM-VII-4: BASIC Statements^2

5. TM-VII-5: Loops
6. TM-VII-6: Looping Statements
7. TM-VII-7: IF-THEN Relational Symbols
8. TM-VII-8: Lists
9. TM-VII-9: Tables
10. TM-VII-10: Subroutines
11. TM-VII-11: A DEF Statement

E. Assignment sheets

1. AS-VII-1: Arithmetic Expressions
2. AS-VII-2: Outputting Data
3. AS-VII-3: Looping Techniques
4. AS-VII-4: Inputting Data
5. AS-VII-5: Lists and Tables
6. AS-VII-6: Functions and Subroutines

F. Answers to assignment sheets

G. Examination

H. Answers to examination

II. References

A. Chirlian, Paul M. Beginning BASIC No. 2. Portland: Dilithium Press, 1978.

B. Didday, Rich, and Page, Rex. Using BASIC. St. Paul: West Publishing Co., 1981.

C. Marateck, Samuel L. BASIC. 2nd ed., New York: Academic Press, Inc., 1982.

D. Pegels, C. Carl, and Verkler, Robert C. BASIC. 3rd ed., San Francisco: Holden-Day, Inc., 1978.

E. Sharpe, William F., and Jacob, Nancy L. BASIC. 3rd ed., New York: The Free Press, 1979.

F. Thompson, Robert G. BASIC A First Course. Columbus, OH: Charles E. Merrill Publishing Co., 1981.

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BASIC PROGRAMMING
UNIT VII

NOTES TO INSTRUCTOR

Since different computer systems may handle the BASIC language differently, you should check the system specifications to determine changes which students need to make on information sheets.

Transparency #2
Use some simple problems to illustrate the effect on the answer of the arithmetic hierarchy.

Transparency #3
Emphasize INPUT and READ and DATA statements as different ways of getting data into the computer to be processed. Emphasize the LET statement as an assignment statement or a calculation statement.

Transparency #4
Emphasize the PRINT literal for prompting the operator what data and how to enter the data for conversational programming. Also, emphasize the PRINT literal for explaining what the output represents.

BASIC PROGRAMMING
UNIT VII

INFORMATION SHEET

I. Terms and Definitions

A. Arithmetic expressions - specifications of the computations to be performed or the value to be obtained

B. Exponentiation - the process of raising a number to a power

C. Variable - a data item whose value is changeable

D. Constant - a data item whose value does not change

E. REM - an unexecuted program command which contains comments regarding the program

F. INPUT - a program command which allows input of data in conversational mode

G. String variable - an alphanumeric field name

H. Field name - a storage location which can be a constant or a variable

I. Input prompt - a symbol telling the operator when to input data

J. READ and DATA - related program commands. READ causes data to be read into the computer from the DATA statement.

K. RESTORE - a program command which causes the computer to read the first data item again in READ-DATA

L. LET - a program command which can be used to assign a value to a variable and to perform calculations

M. PRINT - a program command which causes the computer to display or print desired output

N. PRINT literal - a program command which tells the operator what data and in what form to enter the data

O. TAB - a program command which causes the computer to skip a desired number of spaces when outputting

P. END - a program command which indicates to the computer the end of the program statements

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Q. Unconditional branch - a branch which is always made

R. Conditional branch - a branch which is made when a specific condition is met

S. Nested loop - a loop which is totally inside another larger loop

T. GOTO - a program command which causes an unconditional branch

U. IF-THEN - a program command which causes a conditional branch if a specific condition is met

V. ON - a program command which causes a conditional branch to one of several locations

W. FOR-TO and NEXT - related program commands which set up an automatic loop with a beginning and an ending

X. List - a string of related data items which can be identified

Y. Subscripted variable - a variable containing a character enclosed in parentheses, defining a storage position in a list or table, such as D(6)

Z. Unsubscripted variable - a variable name without a character enclosed in parentheses, such as D

AA. OPTION BASE - a program command which begins a list or table with an item 1 instead of an item 0

BB. Table - a string of related data items arranged in rows and columns

CC. DIM - a program command which reserves a specific amount of space for a list and/or table

DD. Function - a built-in formula which calculates a value

EE. RND - a program function which generates a random number

FF. RANDOMIZE - a program command which selects a starting point to generate a table of random numbers

GG. Subroutine - a mini-program within a program

HH. GOSUB - a program command which transfers control to the beginning of a subroutine

II. RETURN - a program command which transfers control to the statement following the last executed GOSUB

JJ. DEF - a program command which defines a formula as a function

II. BASIC - Beginner's All-purpose Symbolic Instruction Code

- A. Developed at Dartmouth College for simplicity in programming
- B. Commonly used through a computer terminal or on microcomputers
- C. BASIC has many default options.
  - 1. Default options - assumptions made by the language to cause certain computer action if the programmer gives no specific direction
  - 2. Good for beginners to have default options
  - 3. Programmer can override the default options.
- D. BASIC is a mathematically oriented language.
- E. BASIC is not a practical language when large amounts of input and output are required.
- F. All BASIC statements must be numbered.
  - 1. Usually numbered by multiples of 10
  - 2. Additions may be inserted more easily.
  - 3. Deletions are easier to make.
  - 4. Statements will be executed in sequence unless sequence is altered by other statements.

III. Three Basic Requirements In Designing A Program (Refer to TM-VII-1.)

- A. Statements to allow data to be inputted
- B. Statements to process the data which have been inputted
- C. Output statements to see the results of the processing

IV. Arithmetic Expressions in BASIC (Refer to TM-VII-2 and AS-VII-1.)

- A. Specify the computations to be performed
- B. Specify the value to be obtained
- C. Computations are performed according to the arithmetic hierarchy.
  - 1. Inside parentheses

2. Exponentiation

    a. Raises a number to a power

    b. Uses the up arrow (↑) or the caret (^)

3. Multiplication and division

    a. Use the * (asterisk) to indicate multiplication.

    b. Use the / (diagonal) to indicate division.

4. Addition and subtraction

    a. Use the + (plus) to indicate addition.

    b. Use the - (hyphen) to indicate subtraction.

D. Operations on the same level of hierarchy are performed from left to right in the expression.

E. Hierarchy rules can be modified by use of parentheses.

1. Operations inside parentheses are performed first.

2. Operations outside parentheses are performed next.

3. May use parentheses within parentheses

4. Example: Z = ((A + B) - C) / D * E

F. May use variables or constants in expressions

1. Variable - a data item whose value is changeable

2. Constant

    a. A data item whose value does not change

    b. A constant number may be written into the expression.

G. Rules for using numbers in expressions

1. A decimal point may or may not be included.

2. A minus sign precedes a negative number.

3. Commas within numbers are not used.

V. The Remark (REM) Statement (Refer to TM-VII-3.)

A. May explain the purpose of a program

B. May document a program step when used in the middle of a program

C. Has no effect on the program logic

D. Required for using the REM statement

  1. A line number

  2. The keyword REM

  3. Any remark the programmer wants to use

  4. Example: 10 REM THIS PROGRAM CALCULATES THE AMOUNT OF DISCOUNT

VI. The INPUT Statement (Refer to AS-VII-4.)

A. Statement allows information to be inputted as program is being executed (called conversational or interactive methods).

B. Causes system to wait for operator to enter data at appropriate places

C. Required for using the INPUT statement

  1. A line number

  2. The keyword INPUT

  3. The names of fields to be inputted

    a. May include one or more field names, separated by commas, in one input statement

    b. Rules for field names

      1) Must begin with a letter of the alphabet
      2) May include a number or other symbol
      3) Usually limited to two characters; first character only may be alphabetic
      4) Alphanumeric field name - also called "string variables"
        a) Must begin with a single letter of the alphabet
        b) Last character is a dollar sign ($).

      5) Example: 20 INPUT Y, D$, J, Z

D. Execution of an INPUT statement causes a special character to be outputted as an input prompt.

  1. Character is frequently a question mark (varies with systems).

  2. Input prompt tells operator when to input data.

VII. The READ and DATA Statements

   A. Another way to input data where the program executes without interaction

   B. READ and DATA statements must be used together.

   C. READ statement directs computer to read data from a DATA statement.

   D. Required for using the READ statement

      1. A line number

      2. The keyword READ

      3. The name of the field to be read

   E. Data will be read from left to right from DATA statement.

   F. DATA statements frequently written as a group just before the end of the program

   G. Example:

```
 30 READ X, W
160 DATA 20, 25, 16, 89, 74, 86, 33, 62
```

   H. Procedure

      1. Computer assigns first data item (20) to the first variable name (X).

      2. Computer assigns second data item (25) to the second variable name (W).

      3. On a loop (techniques covered later) computer will use third and fourth data items as X and W.

VIII. The RESTORE Statement

   A. Alters the automatic sequence of reading a READ statement from left to right and from top to bottom

   B. RESTORE causes computer to reset and read the first data item again.

   C. Required for using the RESTORE statement

      1. A line number

      2. The keyword RESTORE

IX. The LET Statement

   A. Accomplishes all arithmetic operations

   B. Required for using the LET statement

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1. A line number
2. The keyword LET (optional on some systems)
3. An arithmetic formula
    a. Name of the answer field
    b. An "equals" (=) sign

       (NOTE: The equals sign actually means "to be replaced by.")
    c. The value or arithmetic expression to compute the value for the answer field
    d. May contain as many calculations as necessary
    e. Must follow the arithmetic hierarchy

C. Example: 30 LET R = (D + 1 - Y) / Z * A

X. The PRINT Statement (Refer to TM-VII-4.)

A. Required for using the PRINT statement

1. A line number
2. The keyword PRINT
3. Variable names desired for output

B. Example: 40 PRINT R

C. Default option for printing frequently uses five horizontal print zones.

1. Each print zone frequently contains 15 print positions.
2. Different computer systems may vary from five zones with 15 print positions. Check the system specifications.

D. Printing more than one value with a single PRINT statement (Refer to AS-VII-2.)

1. Separate field names with commas.
    a. Each value is outputted in a separate print zone.
    b. Value for first field name in PRINT is outputted in leftmost zone.
    c. Continues printing to the right for each value.

d. Example: `40 PRINT A, B, C, D`

```
Output:
1___________2___________3___________4
 (15 spaces) (15 spaces) (15 spaces)
```

2. Separate field names with semicolons.

   a. Overrides the print default option

   b. Each value is printed immediately after the previous value beginning at the left.

   c. Example: `40 PRINT A;B;C;D`

```
Output:  1234
```

E. PRINT can also be used to skip a line in output.

1. Use a line number.

2. The keyword PRINT

XI. The PRINT literal - (A literal is also called a "string.")

A. Can be used as an input prompt message to the operator

B. Used in conjunction with an INPUT statement

C. Example 1 causes data to be inputted on next line after prompt message.

Example 1:

```
20 PRINT "ENTER COST AND MARKUP IN THE FORM C,M"
30 INPUT C, M
```

D. Example 2 causes data to be inputted on same line as input prompt message.

Example 2:

```
20 PRINT "ENTER DEPOSIT";
30 INPUT D
```

E. Literal must be enclosed in quotation marks.

F. Quotation marks cause literal to be outputted exactly as inputted.

G. Can be used to output data

Example:

```
90 PRINT "SELLING PRICE IS $";S
```

H. PRINT literal can be used to print headings for output.

   1. Follow PRINT with the desired headings in quotation marks.

   2. Separate headings with a comma after each ending quotation mark.

I. Using a TAB call with PRINT

   1. Causes the computer to tab from the left a desired number of spaces

   2. Used in designing output and overriding the default print zones

   3. Example: 210 PRINT TAB(18); "GROSS"

      Output:
      ```
      __________________GROSS
      ```
      (18 spaces)

XII. The END Statement

   A. Must be the last statement in the program

   B. Indicates the end of program statement

   C. Required for using the END statement

      1. A line number

      2. The keyword END

      3. Example: 50 END

XIII. Two Types of Branches or Loops (Logic leaves the sequential execution of the program.) (Refer to TM-VII-5 and AS-VII-3.)

   A. Unconditional - Branch is <u>always</u> made when the statement is encountered.

   B. Conditional - Branch is made <u>only</u> when a specific condition is met.

   C. Loops may be "nested" (a loop within a loop).

   D. Loops must <u>not</u> cross each other.

XIV. The GOTO Statement (Refer to TM-VII-6.)

   A. Causes an unconditional branch

B. Can cause an endless loop

C. Required for using the GOTO statement

1. A line number

2. The keyword GOTO

3. A line number to which to branch

D. Example: 60 GOTO 30

E. A STOP statement may be used instead of a GOTO directed to the END statement.

XV. The IF-THEN Statement

A. Causes a conditional branch to one location

B. Can be used to end a loop

C. Required for using the IF-THEN statement

1. A line number

2. The keyword IF

3. The relationship between two fields or between a field and a literal

4. The keyword THEN

5. Any correct BASIC statement to be executed if the relationship is true

D. Example: 70 IF Z = 0 THEN GOTO 120

XVI. IF-THEN Relational Symbols (Refer to TM-VII-7.)

A. = means is equal to or is replaced by

B. < means is less than

C. > means is greater than

D. <= means is less than or equal to

E. >= means is greater than or equal to

F. <> means is not equal to

XVII. The ON Statement

A. Causes a conditional branch to one of several line numbers

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B. Required for using the ON statement

   1. A line number
   2. The keyword ON
   3. An arithmetic expression
   4. The keyword GOTO
   5. Each line number, separated with commas, to which the program could branch

C. Example: 80 ON X/Y GOTO 300, 400, 500

D. Procedure

   1. Expression is evaluated and rounded to nearest whole number (integer).
   2. If value of expression is 1, branch is to first line number listed.
   3. If value of expression is 2, branch is to second line number listed.
   4. Procedure continues in above manner to use all line numbers listed.
   5. Can use as many line numbers as needed

XVIII. The FOR-TO and NEXT Statements

A. Controls looping automatically with a beginning and an ending

B. FOR-TO always begins the loop.

C. NEXT must be used to end the FOR-TO loop.

D. Required for using the FOR-TO statement

   1. A line number
   2. The keyword FOR
   3. A field to control the loop (must be an unsubscripted variable which will be discussed later)
   4. An equals sign
   5. The controlling field's beginning value

6. The keyword TO

7. The maximum value allowed in the control field

E. Optional for using the FOR-TO statement

1. The keyword STEP following XVIII, D, 7 above

2. The value to be added to the controlling field on each loop

3. If STEP is not used, value of the increment is assumed to be 1.

F. Required for using the NEXT statement

1. A line number

2. The keyword NEXT

3. The name of the controlling field from XVIII, D, 3 above

G. Values may be literal values or names of fields containing values.

H. Example:

```
 90 FOR G = 1 TO X STEP 2
100
110
120 NEXT G
```

I. Statements between line numbers 90 and 120 in the example will be looped through according to statements on line numbers 90 and 120.

XIX. Use of Lists (Arrays) In A Program (Refer to TM-VII-8.)

A. Use any name to name a list. (Check system's specifications.)

B. The item in the list is enclosed in parentheses.

C. Examples: B(6) refers to the sixth item in list B
D(J) substitutes the value of J and finds that item from a list

D. A letter followed by a digit is illegal for a list indication but not for a field name.

E. Lists are often called "subscripted variables."

F. Regular field names are "unsubscripted variables."

- G. Reading data into a list
    1. Can use FOR-TO and NEXT and READ statements
    2. Example:
       ```
       10 FOR I = 1 to 4
       20 READ P(I)
       30 NEXT I
       40 DATA 36, 42, 87, 17
       ```
    3. First pass through loop, I equals 1
    4. Computer reads 36 as the first item in P.
    5. Second pass through loop, I equals 2
    6. Computer reads 42 as the second item in P.
    7. Continues until all 4 numbers are stored in the list
- H. Can use lists to sort data
- I. Can use lists to print numbers from a list
- J. Can use lists to find largest or smallest number in a list

XX. The OPTION BASE Statement

- A. Computers reserve space for a zero item in lists and tables.
- B. OPTION BASE statement will override the zero item and begin with 1.
- C. Required for using the OPTION BASE statement
    1. A line number
    2. The keyword OPTION BASE
    3. The digit 1 to begin with item 1
    4. Example: `50 OPTION BASE 1`

XXI. Use of Tables In A Program (Refer to TM-VII-9 and AS-VII-5.)

- A. Use any letter to name a table. (Check system's specifications.)
- B. Location within a table is enclosed in parentheses.
    1. Row number listed first

2. Column number listed second

3. Row and column numbers must be separated by commas.

4. Expression may be used to indicate row and/or column.

   a. Computer evaluates the arithmetic expression.

   b. Rounds the result to the nearest integer

C. Example: B(6, X + Y)

D. Can use row numbers up to 10

E. Can use column numbers up to 10 (NOTE: See DIM statement in section XXII.)

F. Should not use the same letter for lists as tables and vice versa

G. Reading data into a table

1. Can use FOR-TO and NEXT and READ statements

2. Example:

```
10 FOR I = 1 TO 2
20 FOR J = 1 TO 2
30 READ S(I,J)
40 NEXT J
50 NEXT I
```

3. Table in example contains 2 rows and 2 columns.

4. DATA statements contain the values to be read by the READ statement and placed in the table.

```
600 DATA 3,5
610 DATA 9,6
```

5. In line number 10 above, I refers to row.

6. In line number 20 above, J refers to column.

7. First pass through the nested loop

   a. Field J will equal 1.

   b. From line number 600, a 3 is read into S in row 1, column 1.

8. Second pass through the nested loop

   a. Field J will equal 2.

        b. From line number 600, 5 is read into S in row 1, column 2.

    9. Will follow procedure from 7 and 8 above only with I reset to 2

        a. From line number 610, 9 is read into S in row 2, column 1.

        b. From line number 610, 6 is read into S in row 2, column 2.

XXII. The DIM Statement

A. Used to reserve a specific amount of space in a list and/or table

B. Example: `10 DIM B(125), X(12,15)`

C. Contains space for 125 items in list B

D. Contains space for 12 rows and 15 columns in table X

E. DIM statement should precede any other reference to the list or table.

F. Expressions may <u>not</u> be used in a DIM statement.

XXIII. Calculating Different Functions

A. Functions are usually indicated by a three-letter name. (Check system's specifications.)

B. Value to be used is indicated in parentheses following the function name.

C. Mathematical functions (X represents the value or expression.)

Name — Description

1. SQR(X) - Finds the square root of X
2. LOG(X) - Finds the natural logarithm of X
3. EXP(X) - Finds the value of e(2.718) to the power of X
4. ABS(X) - Finds the absolute value of X
5. ATN(X) - Finds the arctangent of X(in radians)
6. SIN(X) - Finds the sine of X(in radians)

7. COS(X) - Finds the cosine of X(in radians)

8. TAN(X) - Finds the tangent of X(in radians)

9. COT(X) - Finds the cotangent of X(in radians)

10. INT(X) - Finds the greatest integer less than or equal to X

11. SGN(X) - Finds the sign of X as +1, -1, or 0

XXIV. Selecting Random Numbers

A. RND (Check system's specifications.)

1. Will select a random number

2. Example: LET J=RND generates a random number between 0 and 1.

3. Example: LET X=38*RND selects a random number between 0 and 38.

4. Example: LET X=INT(1+(38*RND)) selects an integer random number between 0 and 38.

B. RANDOMIZE

1. Generates random numbers beginning at a starting point selected by the computer

2. Generally uses an internal clock for this purpose

XXV. Subroutine - a procedure to be followed in several places in a program (Refer to TM-VII-10 and AS-VII-6.)

A. Eliminates rewriting the procedure each time

B. GOSUB

1. Similar to a GOTO

2. Directs computer to transfer to the beginning of the subroutine

3. Directs computer to remember where it was in the program before the transfer

C. Example: 40 GOSUB 240

D. Example above will cause transfer to line number 240.

E. Line number 240 will begin the subroutine.

F. The last statement in the subroutine will use the keyword RETURN.

G. RETURN transfers control to the statement following last executed GOSUB.

H. Programmer may wish to use REM statement as first statement in subroutine.

I. May use a subroutine within a subroutine, but may not reference a subroutine that is presently executing

J. Computer must always enter a subroutine because of a GOSUB statement.

XXVI. The DEF Statement (Refer to TM-VII-11.)

A. Used to define a formula as a function

B. Function must be named with three letters. (Check system's specifications.)

   1. First two letters are FN.

   2. Programmer selects third letter.

C. Required for using the DEF statement

   1. A line number

   2. The keyword DEF

   3. The name of the formula (FN?)

   4. An equals sign

   5. The formula to be used as a function

   6. Example: 30 DEF FNI = P*R*T/360

D. The DEF statement should appear before referring to the function.

E. The DEF statement is not executed directly; the function presented is used in another statement.

F. Two functions should not be defined so that they refer to each other.

Three Requirements for Writing a Program

1. INPUT
   Getting Data into the Program

2. PROCESSING
   Performing Necessary Manipulations

3. OUTPUT
   Printing or Displaying the Results

THE ARITHMETIC HIERARCHY

1. Inside PARENTHESES
2. EXPONENTIATION
3. MULTIPLICATION and DIVISION
4. ADDITION and SUBTRACTION
5. LEFT to RIGHT

TM-VII-3

BASIC STATEMENTS[1]

A REM statement

```
10 REM THIS PROGRAM CALCULATES
     THE AMOUNT OF DISCOUNT
```

An INPUT statement

```
20 INPUT Y,D$,J,Z
```

READ and DATA statements

```
 30 READ X,W
160 DATA 20,25,16,89,74,86,33,62
```

A LET statement

```
30 LET R =(D+1-Y)/Z*A
```

BASIC STATEMENTS[2]

PRINT statements

```
40 PRINT R
40 PRINT A,B,C,D
40 PRINT A;B;C;D
```

PRINT literals

```
20 PRINT "ENTER COST AND MARKUP
     IN THE FORM C,M"
20 PRINT "ENTER DEPOSIT"
90 PRINT "SELLING PRICE IS $";S
```

TAB call for PRINT

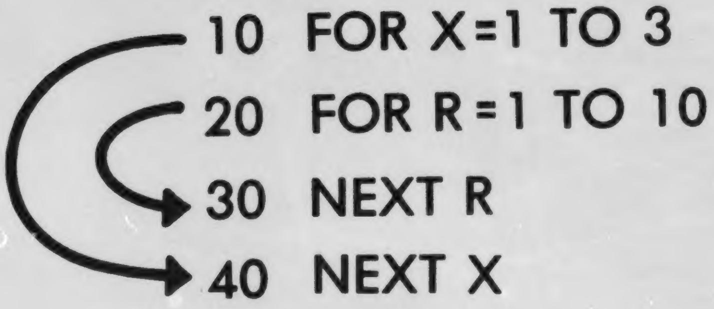
```
210 PRINT TAB(18); "GROSS"
```

An END statement

```
50 END
```

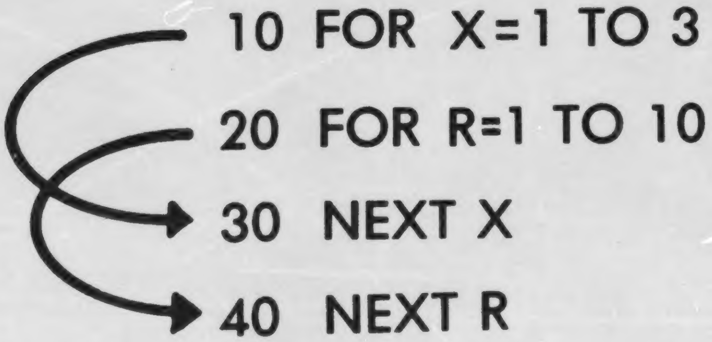
LOOPS

NESTED LOOP



```
10  FOR X=1 TO 3
20  FOR R=1 TO 10
30  NEXT R
40  NEXT X
```

ILLEGAL LOOP



```
10 FOR  X=1 TO 3
20  FOR R=1 TO 10
30  NEXT X
40  NEXT R
```

TM-VII-6

LOOPING STATEMENTS

A GOTO statement

```
60 GOTO  30
```

AN IF-THEN statement

```
70 IF Z=0 THEN GOTO 120
```

An ON statement

```
80 ON X/Y GOTO 300,400,500
```

A FOR-TO, NEXT statement

```
 90 FOR G=1 TO X STEP 2
100
110
120 NEXT G
```

IF-THEN
RELATIONAL SYMBOLS

SYMBOL	MEANS
=	is equal to
>	is greater than
<	is less than
>=	is greater than or equal to
<=	is less than or equal to
<>	is not equal to

LISTS

B(6) is item 6 in List B

D(J) is item J in List D

STORING A LIST

```
10 FOR I = 1 TO 4
20 READ P(I)
30 NEXT I
40 DATA 36,42,87,17
```

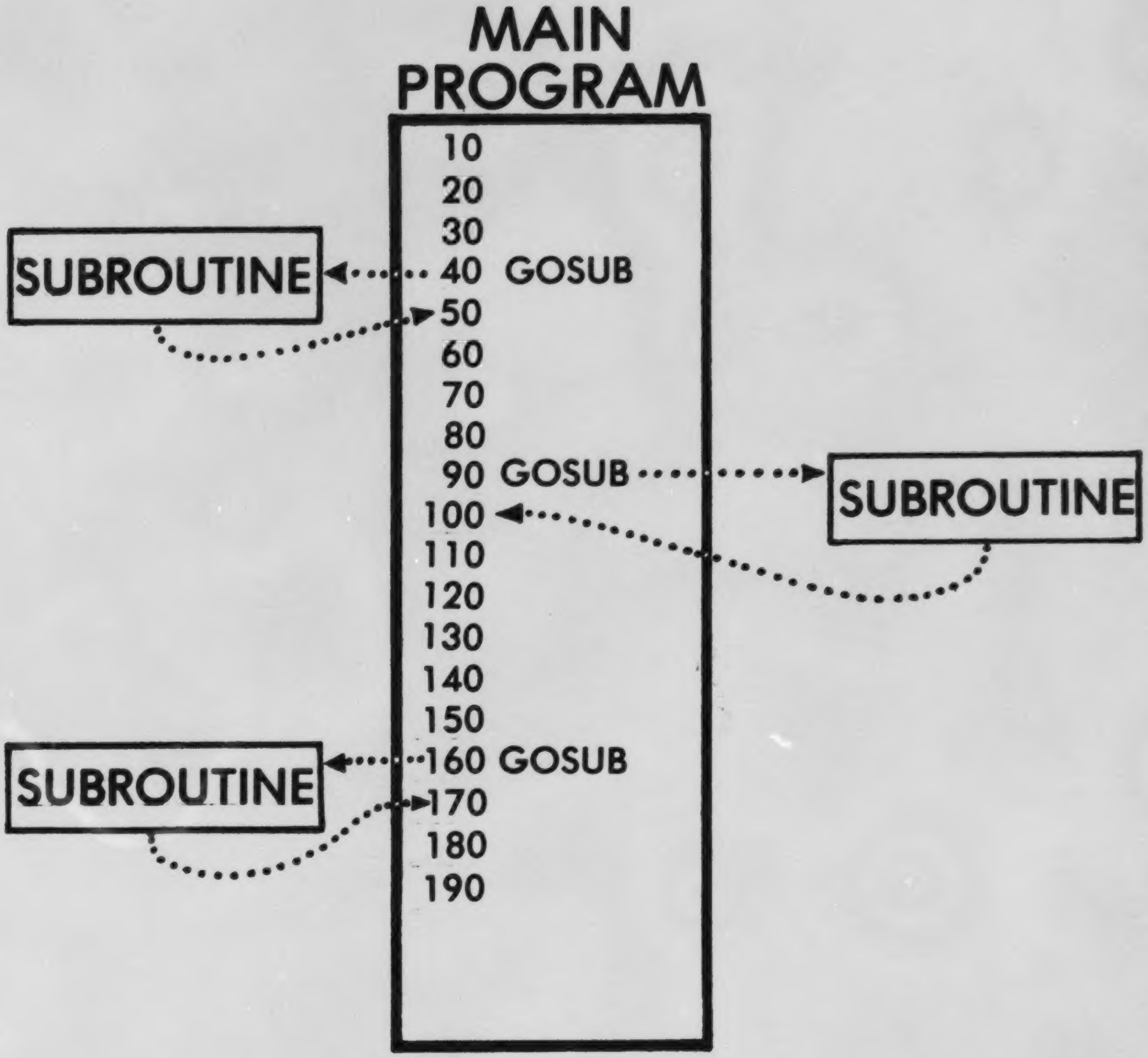
TABLES

B(6,X+Y) is Table B, Row 6, Column (X+Y)

STORING A TABLE

```
10 FOR I=1 TO 2
20 FOR J=1 TO 2
30 READ S(I,J)
40 NEXT J
50 NEXT I
------------
600 DATA 3,5
610 DATA 9,6
```

SUBROUTINES


MAIN
PROGRAM
10
20
30
SUBROUTINE
40 GOSUB
50
60
70
80
90 GOSUB
SUBROUTINE
100
110
120
130
140
150
SUBROUTINE
160 GOSUB
170
180
190

A DEF STATEMENT

```
30 DEF FNI =P*R*T/360
```

BASIC PROGRAMMING
UNIT VII

ASSIGNMENT SHEET #1: ARITHMETIC EXPRESSIONS

Directions: Determine if each of the following arithmetic expressions is legal or illegal by circling legal or illegal. Also, state why the expression is legal or illegal.

1. 6 Legal or illegal Why?

2. Y Legal or illegal Why?

3. A4 + B2 Legal or illegal Why?

4. A x B/C Legal or illegal Why?

5. $\frac{X + Y}{Z}$ Legal or illegal Why?

6. H26 * Y Legal or illegal Why?

7. ((A+B)*(C+D) Legal or illegal Why?

8. -8 Legal or illegal Why?

9. X(A+F) Legal or illegal Why?

10. D$ Legal or illegal Why?

BASIC PROGRAMMING
UNIT VII

ASSIGNMENT SHEET #2: OUTPUTTING DATA

Directions: Complete the following exercises.

A. Show how the output would be shown for each of the following PRINT statements.

1. PRINT A (if A=35)

2. PRINT R, S (if R=16, S=27)

3. PRINT "PRICE IS $" ; P (if P=9)

4. PRINT "PRICE IS $" , P (if P=9)

5. PRINT R : S (if R=21, S=46)

6. PRINT "PAY = $" ; 25,300

7. PRINT "PRICE IS",

8. PRINT "A PENNY SAVED" ; TAB (23); "IS A PENNY EARNED"

B. Write a PRINT command that will print the letter X in the center of the first print zone.

BASIC PROGRAMMING
UNIT VII

ASSIGNMENT SHEET #3: LOOPING TECHNIQUES

Directions: Complete the following exercises.

A. Given the set of data presented below, indicate for each statement whether or not the computer will branch to line number 700. If your answer is no, state why.

Data A=6 B=9 D=7 R1=25

1. IF A< D THEN 700
2. IF D< A THEN 700
3. IF R1 >= B THEN 700
4. IF B<> A THEN 700
5. IF X = A THEN 700
6. IF B<= D THEN 700

B. Indicate if each of the following GOTO statements will execute.

1. GOTO 99
2. GOTO S
3. GOTO LET
4. GOTO 10

C. Indicate if each of the following statements would execute.

1. ON Y GOTO 100, 120, Z
2. ON 1, 2, 3, GOTO 100, 150, 200
3. ON H/L GOTO 50, 75, 100

D. Explain why the following series of loops is illegal.

```
FOR I = 1 TO 5
FOR K = 1 TO 6
NEXT I
NEXT K
```

E. Rearrange the program portion in the preceding problem to "nest" the loops.

F. Explain how the following program portion will be executed.

```
10 FOR A = 1 TO 3
20 IF A = 3 THEN 50
30 PRINT A
40 NEXT A
50 END
```

BASIC PROGRAMMING
UNIT VII

ASSIGNMENT SHEET #4: INPUTTING DATA

Directions: Complete the following exercises.

A. Indicate how the data from each DATA statement will be read by the accompanying READ statement.

1.
```
READ C
DATA 6, 12, 18
```

2.
```
READ A, B, C + D
```

3.
```
READ C, D,
```

4.
```
READ X, Y
DATA 5, 10, 15, 20, 25
```

5.
```
READ S, T, U
DATA 1, 2, 3, 4, 5, 6, 7, 8, 9
```

B. Will the following program read data? Why or why not?

```
10 REM ADD NUMBERS
20 PRINT "ENTER TWO NUMBERS TO BE ADDED"
30 LET C = A + B
40 PRINT C
50 END
```

C. Assume that you have responded to each of the input prompts below. Did you respond correctly or incorrectly? Why?

1. HOW OLD ARE YOU? I AM 17

2. HOW MANY FEET IN A MILE? 5,280

3. HOW MANY INCHES IN A FOOT? 12

4. WHAT PORTION OF A POUND IS 8 OUNCES? 1/2

5. WHAT PORTION OF A POUND IS 8 OUNCES? .5

ASSIGNMENT SHEET #5: LISTS AND TABLES

Directions: Complete the following exercises.

A. If you could crawl into the computer to find items of data in a list, determine where you would look. Indicate list and position.

1. B(6)
2. X(18)
3. P(256)
4. T(A+B) If A = 3, B = 3.4
5. D(J) If J = 9

B. You are still looking for data as in 1 above except in a table. Determine where you would find these items of data in a table.

1. A(2, 4)
2. L(1, 9)
3. F(3, D) If D = 4
4. S(X + Y, 3) If X = 6, Y = 9

BASIC PROGRAMMING
UNIT VII

ASSIGNMENT SHEET #6: FUNCTIONS AND SUBROUTINES

Directions: Complete the following exercises.

A. Write a statement that will calculate the square root of 97 and assign the square root to variable X.

B. Write a subroutine that will determine the number of hours worked over 40 and calculate overtime pay if the overtime rate is 1½ times the regular pay rate.

C. Write the necessary statements so that your program will call the subroutine you wrote in #2 above.

D. Explain how and where the computer returns to the program after completing the subroutine. Use #2 and #3 above to determine your answers.

BASIC PROGRAMMING
UNIT VII

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET #1

1. Legal - The number 6 is a constant.
2. Legal - The letter Y represents a variable.
3. Legal - Both A4 and B2 are valid variable names.
4. Illegal - Multiply sign is *, not X.
5. Illegal - Divide sign is /.
6. Illegal - H26 is not a valid variable name.
7. Illegal - Parentheses must be paired.
8. Legal - A valid negative constant
9. Illegal - Must use the multiply sign *.
10. Legal - Indicates a string variable for alphanumeric data

ASSIGNMENT SHEET #2

```
A.  1.  35
    2.  16_____________27
          (13 spaces)
    3.  PRICE IS $9
    4.  PRICE IS $_____9
                 (5 spaces)
    5.  2146
    6.  PAY = $25   300
    7.  PRICE IS
    8.  A PENNY SAVED         IS A PENNY EARNED

B.  PRINT "_______X"
          (7 spaces)
```

ASSIGNMENT SHEET #3

A.
1. Yes
2. No - 7 is not less than 6.
3. Yes
4. Yes
5. No - No value is given for X.
6. No - 9 is greater than 7.

B.
1. Control will transfer to line number 99.
2. Will not execute - must transfer to a line number
3. Will not execute - must transfer to a line number
4. Control will transfer to line number 10.

C.
1. Will not execute - must transfer to a line number
2. Will not execute - must use one value after ON statement

610

3. If expression = 1, control transfers to line number 50.
   If expression = 2, control transfers to line number 75.
   If expression = 3, control transfers to line number 100.

D. Loops must be nested, or loops may not cross each other.

E.
```
FOR I = I TO 5
FOR K = 1 TO 6
NEXT K
NEXT I
```

F. On the first loop, the computer will print a 1.
On the second loop, the computer will print a 2.
On the third loop, when A = 3, the control will transfer to line number 50.

ASSIGNMENT SHEET #4

A.
1. C will be given a value of 6.
   C will be given a value of 12.
   C will be given a value of 18.
2. Cannot read expressions such as C + D
3. Dangling comma at the end of READ statement is illegal.
4. Reads 5 as X and 10 as Y.
   Reads 15 as X and 20 as Y.
   Illegal - Data must be paired; 25 needs a partner.
5. Reads S = 1, T = 2, U = 3
   Reads S = 4, T = 5, U = 6
   Reads S = 7, T = 8, U = 9

B. No - There is no INPUT statement to allow data to be entered.

C.
1. Incorrect - cannot respond with words
2. Incorrect - Comma indicates two numbers in input.
3. Correct answer and correct form
4. Incorrect - 1/2 is an arithmetic expression.
5. Correct - Decimal input is permitted.

ASSIGNMENT SHEET #5

A.
1. List B, Item 6
2. List X, Item 18
3. List P, Item 256
4. List T, Item 6
5. List D, Item 9

B.
1. Table A, Row 2, Column 4
2. Table L, Row 1, Column 9
3. Table F, Row 3, Column 4
4. Table S, Row 15, Column 3

ASSIGNMENT SHEET #6

```
A.  LET X = SQR(97)
B.  LET H2 = H1 - 40
    LET W = R * H2 * 1.5
    RETURN
C.  GOSUB 40
```

D. RETURN statement causes the computer to automatically return to the next statement following the GOSUB statement.

BASIC PROGRAMMING
UNIT VII

EXAMINATION

1. Briefly discuss.

   a. Default options:

   b. How and why BASIC statements are numbered:

2. Itemize and explain the three basic requirements in designing a program.

   a.

   b.

   c.

3. State the arithmetic hierarchy, including the use of parentheses, from highest order to lowest order.

4. Write a correct REM statement to include your name and a description of a problem the computer could solve.

5. Write a correct INPUT statement that will allow the operator to input data for these three variables: principal, rate, days.

6. Write READ and DATA statements that will read data for the principal, rate, days.

7. Briefly explain the purpose of a RESTORE statement.

8. Write a correct LET statement that will multiply principal times rate times days and divide by 360 days, then add this interest amount to the beginning principal to equal maturity value.

9. Write a correct PRINT statement that will output the principal, rate, days, interest amount, and maturity value in separate columns.

10. Write a PRINT literal statement that will prompt the operator when to enter the three variables in correct order: principal, rate, days.

11. Briefly explain why a program needs an END statement.

12. Compare an unconditional branch and a conditional branch.

13. Briefly explain what happens when the computer acts on a GOTO statement.

14. Explain how the following statement will cause the computer to function: 40 IF P = 0 THEN GOTO 210.

15. Match the IF-THEN relational symbols in Column B with their correct meaning in Column A.

	Column A		Column B
____a.	is equal to	1.	<=
____b.	is less than	2.	<>
____c.	is greater than	3.	=
____d.	is less than or equal to	4.	>
____e.	is greater than or equal to	5.	<
____f.	is not equal to	6.	>=

16. Explain how the following statement will cause the computer to function: 120 ON A/B GOTO 150, 180, 240

17. Write a FOR-TO and NEXT loop that will perform this calculation, LET I = I * 1.10, four times in increments of two.

18. Explain how a list is created by this program portion:

```
40 FOR R = 1 TO 5
50 READ D(R)
60 NEXT R
70 DATA 2, 4, 6, 8, 10
```

19. Explain the function of an OPTION BASE command.

20. Given the statements in Column A, give correct responses in Column B indicating Table name, Table row, and Table column.

Column A	Column B
a. X(3,7)	Table ______, Row ______, Column______
b. R(A+B,2)	Table ______, Row ______, Column______
c. A(6,D-J)	Table ______, Row ______, Column______

21. Space for how many items is reserved in these lists based on this DIM statement: 20 DIM C(63), S(12).

22. Column A lists descriptions of various functions. Match the function names from Column B with the correct description in Column A.

Column A	Column B
____a. Finds the square root of X	1. SGN(X)
____b. Finds the sign of X as +1, -1, or 0	2. INT(X)
____c. Finds the sine of X(in radians)	3. SQR(X)
____d. Finds greatest integer less than or equal to X	4. SIN(X)

23. Assume that you are drawing for a prize and want a random number between 1 and 100. Write a correct statement to give you that integer number.

24. Give the command to cause the computer to go to a subroutine in line number 180 and return to the next program line in the original program, line number 60.

25. Explain the purpose of a DEF statement.

BASIC PROGRAMMING
UNIT VII

ANSWERS TO EXAMINATION

1. a. Assumptions made by the BASIC language to cause certain computer action if the programmer gives no specific directions
   b. Usually numbered in multiples of 10 to make additions and deletions easier

2. a. Input - allows data to enter the program
   b. Processing - causes manipulations of the data
   c. Output - prints or displays the results of the processing

3. Inside parentheses first
   Exponentiation second
   Multiplication and division third
   Addition and subtraction last
   All performed from left to right

4. REM (your name) CALCULATES SIMPLE INTEREST

5. INPUT P, R, D

6. READ P, R, D
   DATA 150, 16, 60

7. Causes the computer to reset to the first item of data from a DATA statement and read that first item of data again

8. LET M = P +(P * R * D / 360) Parentheses optional

9. PRINT P, R, D, I, M

10. PRINT "ENTER PRINCIPAL, RATE, DAYS IN THE FORM P, R, D"

11. To indicate the final statement in the program

12. An unconditional branch always happens.
    A conditional branch happens if a specific condition is met.

13. A GOTO statement always causes an unconditional branch.

14. When variable P is equal to 0, control passes to line number 210.

15. a. 3
    b. 5
    c. 4
    d. 1
    e. 6
    f. 2

16. The computer will calculate a value for A/B. When that value is 1, control passes to line number 150. When that value is 2, control passes to line number 180. When that value is 3, control passes to line number 240.

17.
```
FOR X = 2 TO 8 STEP 2
LET I = I * 1.10
NEXT X
```

18. First pass through the loop, R = 1 and D(1) is assigned a value of 2
Second pass through the loop, R = 2 and D(2) is assigned a value of 4
Third pass through the loop, R = 3 and D(3) is assigned a value of 6
Fourth pass through the loop, R = 4 and D(4) is assigned a value of 8
Fifth and last pass through the loop, R = 5 and D(5) is assigned a value of 10

19. OPTION BASE overrides the zero item in a list or table and begins the list or table with item 1.

20. Table X, Row 3, Column 7
Table R, Row A + B, Column 2
Table A, Row 6, Column D - J

21. In List C, space is reserved for 63 items.
In List S, space is reserved for 12 items.

22.
a. 3
b. 1
c. 4
d. 2

23.
```
LET X = INT (1 + (100 * RND))
```

24.
```
GOSUB 180
RETURN
```

25. The DEF statement is used to define a formula as a function.

RPG COMPUTER PROGRAMMING
UNIT VIII

UNIT OBJECTIVE

After completing this unit on RPG Programming, students should be able to write simple business programs using RPG.

SPECIFIC OBJECTIVES

After completion of this unit, students should be able to:

1. Match terms associated with RPG programming.
2. Explain the four arithmetic operations used in RPG.
3. Explain the operation of the Compare statement.
4. Define a control break and give an example.
5. Explain the difference between RECORD IDENTIFYING INDICATORS and FIELD RECORD RELATION INDICATORS.
6. Name the purpose of the EXCEPT operation.
7. Write RPG programs using concepts developed in Objectives 1 through 7.

RPG COMPUTER PROGRAMMING
UNIT VIII

SUGGESTED ACTIVITIES

I. Instructor

   A. Provide students with objectives.

   B. Provide students with information and assignment sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information sheets.

   F. Provide handouts and assignment and job sheets.

   G. Give examination.

II. Student

   A. Read objectives.

   B. Study information sheets and handouts.

   C. Complete assignment and job sheets.

   D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit Content

   A. Objectives

   B. Information sheets

   C. Handouts

      1. HO-VIII-1: Sample Problem of Input/Output

      2. HO-VIII-2: Sample Problem of Arithmetic Operations

      3. HO-VIII-3: Sample Problem of Comparison and Multiply Operations

      4. HO-VIII-4: Sample Problem of Control Breaks

5. HO-VIII-5: Sample Problem of Multiple Control Breaks
6. HO-VIII-6: Sample Problem of Multiple Record Types
7. HO-VIII-7: Sample Problem of Exception Output

D. Transparency masters

1. TM-VIII-1: File Description Specifications Form
2. TM-VIII-2: Input Specifications Form
3. TM-VIII-3: Output Specifications Form
4. TM-VIII-4: Printing Headings
5. TM-VIII-5: Printing Total Lines
6. TM-VIII-6: RPG II Fixed Logic - Multiple Control Breaks
7. TM-VIII-7: L1, L2, L3 Control Breaks
8. TM-VIII-8: Sequenced Multiple Record Types

E. Assignment sheets

1. AS-VIII-1: Introduction To RPG
2. AS-VIII-2: Arithmetic Operations
3. AS-VIII-3: Comparing
4. AS-VIII-4: Control Breaks
5. AS-VIII-5: Multiple Control Breaks
6. AS-VIII-6: Multiple Record Types
7. AS-VIII-7: Exception Output

F. Answers to assignment sheets

G. Job sheets

1. JS-VIII-1: Input/Output
2. JS-VIII-2: Arithmetic Operations and Edit Codes
3. JS-VIII-3: Comparing
4. JS-VIII-4: Control Breaks
5. JS-VIII-5: Multiple Control Breaks

6. JS-VIII-6: Multiple Record Types

7. JS-VIII-7: Exception Output

H. Examination

I. Answers to examination

II. References

A. Bux, William E., and Cunningham, Edward C. RPG and RPG II Programming: Applied Fundamentals. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1980.

B. Shelly, Gary B., and Cashman, Thomas J. Computer Programming RPG II. Fullerton, CA: Anaheim Publishing Company, 1978.

RPG COMPUTER PROGRAMMING
UNIT VIII

INFORMATION SHEET

I. Terms, Definitions, and Introduction to RPG (Refer to AS-VIII-1, JS-VIII-1, and HO-VIII-1.)

  A. Programming steps

    1. Problem definition

    2. Problem analysis

    3. Coding - writing down steps in programming language

    4. Program compilation - process of sending program through computer

      a. Source program - RPG (Report Program Generator) statements written by programmer

      b. Compiler - program supplied by manufacturer for purpose of translating RPG to machine language instructions

      c. Object program - machine language instructions generated by the compiler from RPG source statements

    5. Program testing - determination if program is correct and data are processed properly

    6. Documentation - recording in an organized form all the facts concerning a program

  B. Introduction to RPG Programming

    1. File description specifications form - defines input file and output file (Refer to TM-VIII-1.)

    2. Input specifications form - defines the fields in the input record (Refer to TM-VIII-2.)

    3. Output specifications form - defines the format of the results (Refer to TM-VIII-3.)

    (NOTE: Pay particular attention to fields containing entries on the above transparencies. Refer to programming manual for more detail.)

    4. Rules for creating file and field names

a. Length

    1) File names, maximum 8
    2) Field names, maximum 6

b. No embedded blanks

c. Must begin with alpha character

d. Refer to programming manual for further restrictions.

II. Arithmetic Operations and Edit Codes (Refer to AS-VIII-2, JS-VIII-2, and HO-VIII-2.)

A. Addition operation - Factor 1 is added to Factor 2 and answer placed in result field; use ADD in operation field.

B. Subtraction operation - Factor 2 is subtracted from Factor 1 and answer placed in result field; use SUB in operation field.

C. Multiplication operation - Factor 1 is multiplied by Factor 2 and answer placed in result field; use MULT in operation field.

D. Division operation - Factor 1 is divided by Factor 2 and answer placed in result field; use DIV in operation field.

E. Input specifications form consideration - Entry must be made in decimal positions field when field or input record is to be used in calculation or is to be edited.

F. Calculations specification form - contains all calculations

1. Calculations are processed based on the conditions of certain indicators.

2. Result field - where answer is stored; must indicate length and decimal positions

3. Numeric literal - actual numeric values which can be specified in Factor 1 or Factor 2

G. Printing headings (Refer to TM-VIII-4.)

H. Editing - when special characters such as commas, periods, and dollar signs are to be placed in a numeric field which is to be printed

1. Zero suppression - "Z" is entered in column 38 of output and results in leading zeros being replaced by blanks

        2. Edit code 1 - prints a numeric field with commas and decimal point. If the value is zero, zero will be printed.

        3. Edit code 2 - works same as (2) except prints blanks if value is zero

        4. Other edit codes - 3, 4, A, B, C, D, J, K, L, M, X, Y, Z (Refer to programming manual for specifics.)

        5. Floating dollar sign - suppresses leading zeros and inserts dollar sign to the left of the most significant digit

III. Comparing (Refer to AS-VIII-3, JS-VIII-3, and HO-VIII-3.)

    A. Basic comparing concepts

        1. Numeric fields are equal.

        2. Numeric fields are unequal.

        3. One numeric field is less than a second numeric field.

        4. One numeric field is greater than a second numeric field.

    B. Comparing alphabetic fields - Value of each letter of alphabet is greater as alphabet progresses from A - Z.

    C. COMP operation

        1. Contents of field or literal in Factor 1 are compared to contents in Factor 2.

        2. Outcome of operation can be used to set on indicators in column 54 - 59 (>,<, =)

    D. Comparison rules

        1. Different size numeric fields - fields compared beginning at right and moving to left

        2. Alphabetic and alphanumeric comparisons - comparison begins with the extreme left character and proceeds to the right

        3. Literal comparisons

            a. Alphanumeric literal must be contained within apostrophes.

            b. Numeric literal does not have apostrophes. (Decimal point and negative sign are optional.)

IV. Control Breaks (Refer to AS-VIII-4, JS-VIII-4, and HO-VIII-4.)

A. Definition - when the value in a given input field changes from the value read on a previous input record

B. RPG allows up to nine different control breaks to be processed.

C. Input specifications

1. Must be an entry in Control Level Field in columns 59 - 60

2. Valid entries are L1, L2, L3, L4, L5, L6, L7, L8, and L9.

D. Calculation specifications - used for accumulating totals which are to be printed when a control break occurs

E. Output specifications

1. Contains total lines for control breaks

2. Blank After Option - Column 39 contains a "B" if the field is to be reset to zero after being printed.

F. RPG fixed logic - sequence in which operations will occur in the object program generated by the RPG compiler

G. Example of single level control break logic

1. Housekeeping routines are processed and headings, if required, are written.

2. A check is made to determine if detail lines are to be printed, and then record is read into the input area.

3. Test for last record is performed, the proper Record Identifying Indicator is turned "on", and a check is performed for a control break.

4. Data in input area are moved to input fields and detail calculations are processed.

5. Detail lines are printed on the report.

6. Input record is read.

7. Record Identifying Indicator is set "on".

8. If applicable, the total calculations and total output are processed, and then the detail calculations are performed.

9. The detail lines are printed.

10. Next data record is read. The value in the control field is different from the previous record, causing a control break.

11. The L1 total calculations are performed, the L1 total lines are printed, and then the detail time calculations are performed for the card that caused the control break. (Refer to TM-VIII-5.)

12. The last card is read and the L1 and LR indicators are turned "on".

H. Example of multiple level control break logic (Refer to AS-VIII-5, JS-VIII-5, HO-VIII-5, TM-VIII-6, and TM-VIII-7.)

V. Field Record Relations, Multiple Record Types, and Look Ahead (Refer to AS-VIII-6, JS-VIII-6, and HO-VIII-6.)

A. Record identifications codes - input specifications

1. Indicates type of record to be processed

2. Columns 21 - 41 are used to specify the values which are to be found in the input record.

3. Whenever codes specified in column 21 - 41 are found in an input record, the record identifying indicator which is specified on the same line is turned "on".

B. Field record relations - columns 63 - 64

1. Indicates which fields will be in a particular record

2. If a field is contained in all records, no entry must be made.

3. If a field is contained in one type of record and not another, then the record identifying indicator must be entered in columns 63 - 64 of input specifications.

C. Sequenced multiple record types and entries (Refer to TM-VIII-8.)

D. Look ahead feature (columns 19 - 20) - allows program to inspect the contents of the record following the card being processed

E. GOTO and TAG statements

   1. Used to bypass a sequence of instructions on the calculation specifications

   2. Cause a transfer of control from the point at which GOTO is specified to the instruction following the named TAG statement

F. Internal subroutines - a group of operations which are executed when requested from the main instructions on the calculation specifications

   1. EXSR instruction - control passes to the instructions in the internal subroutine

   2. Instructions in internal subroutine are executed beginning with instruction following BEGSR operation and continuing until the ENDSR instruction is encountered.

   3. Once ENDSR instruction is encountered, control passes back to instruction immediately following the EXSR instruction.

VI. Exception Output (Refer to AS-VIII-7, JS-VIII-7, and HO-VIII-7.)

A. Operation EXCPT allows records to be written during total or detail calculation time.

B. Operation is used when it is desired to produce a variable number of output records in one cycle.

   Example - EXCPT operation may be used to produce a variable number of output records with all having the same information on them.

C. Each time EXCPT operation is executed, all output indicated by entry E in column 15 of output specifications will be written.

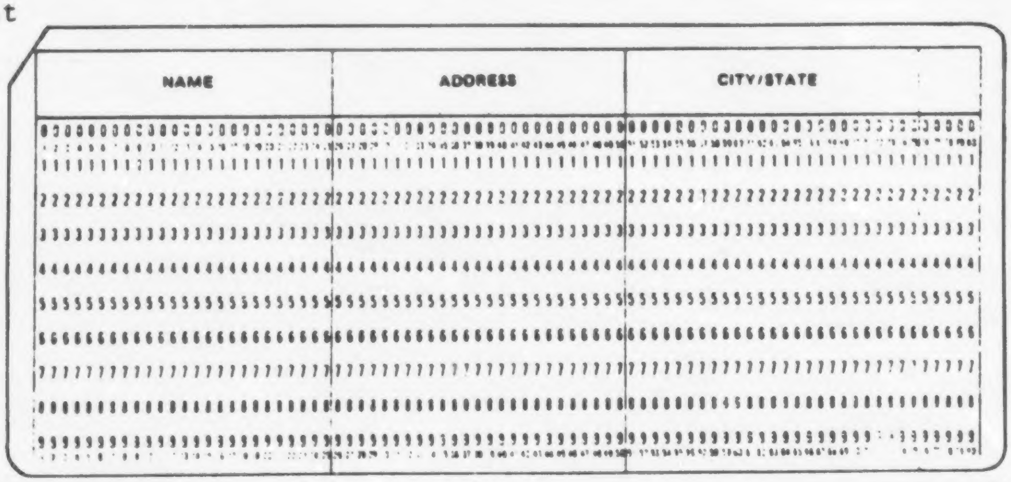
D. Exception line is defined on output specifications after all other types of lines.

RPG COMPUTER PROGRAMMING
UNIT VIII

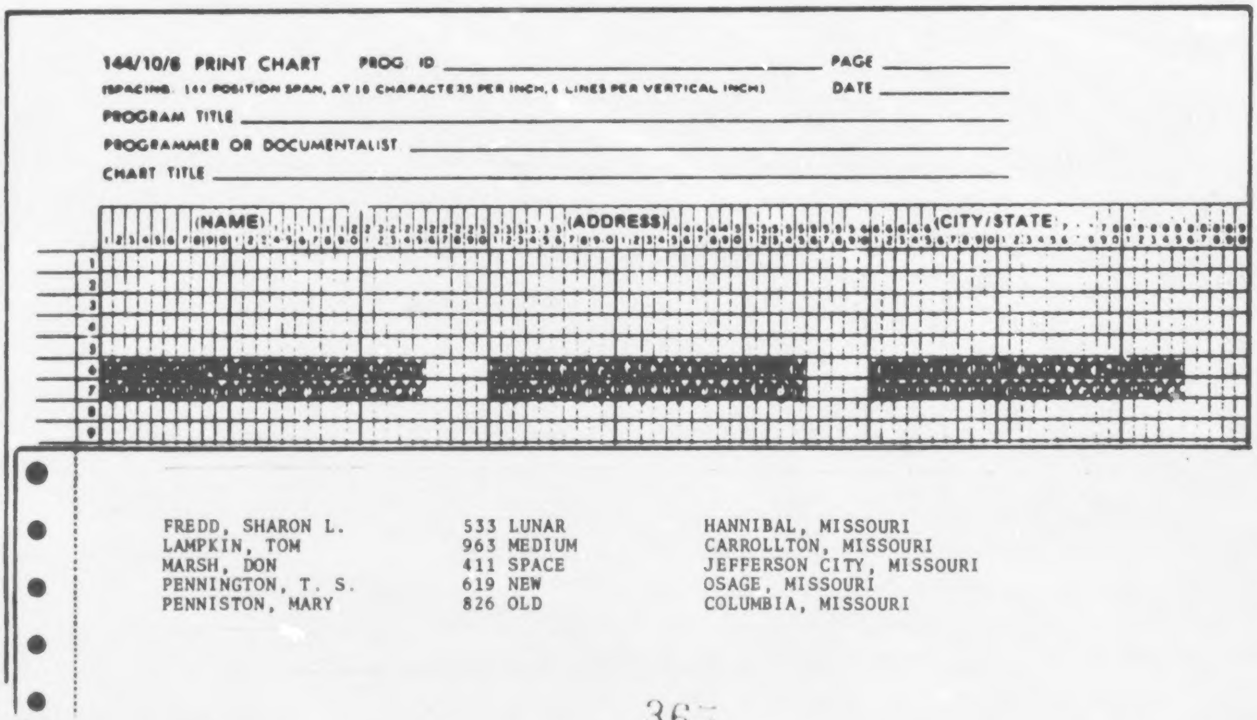
HANDOUT #1: SAMPLE PROBLEM OF INPUT/OUTPUT

This example involves the preparation of a Name and Address Listing from a file of Name and Address Cards. The format of the input cards and the format of the printed report are illustrated below.

Input

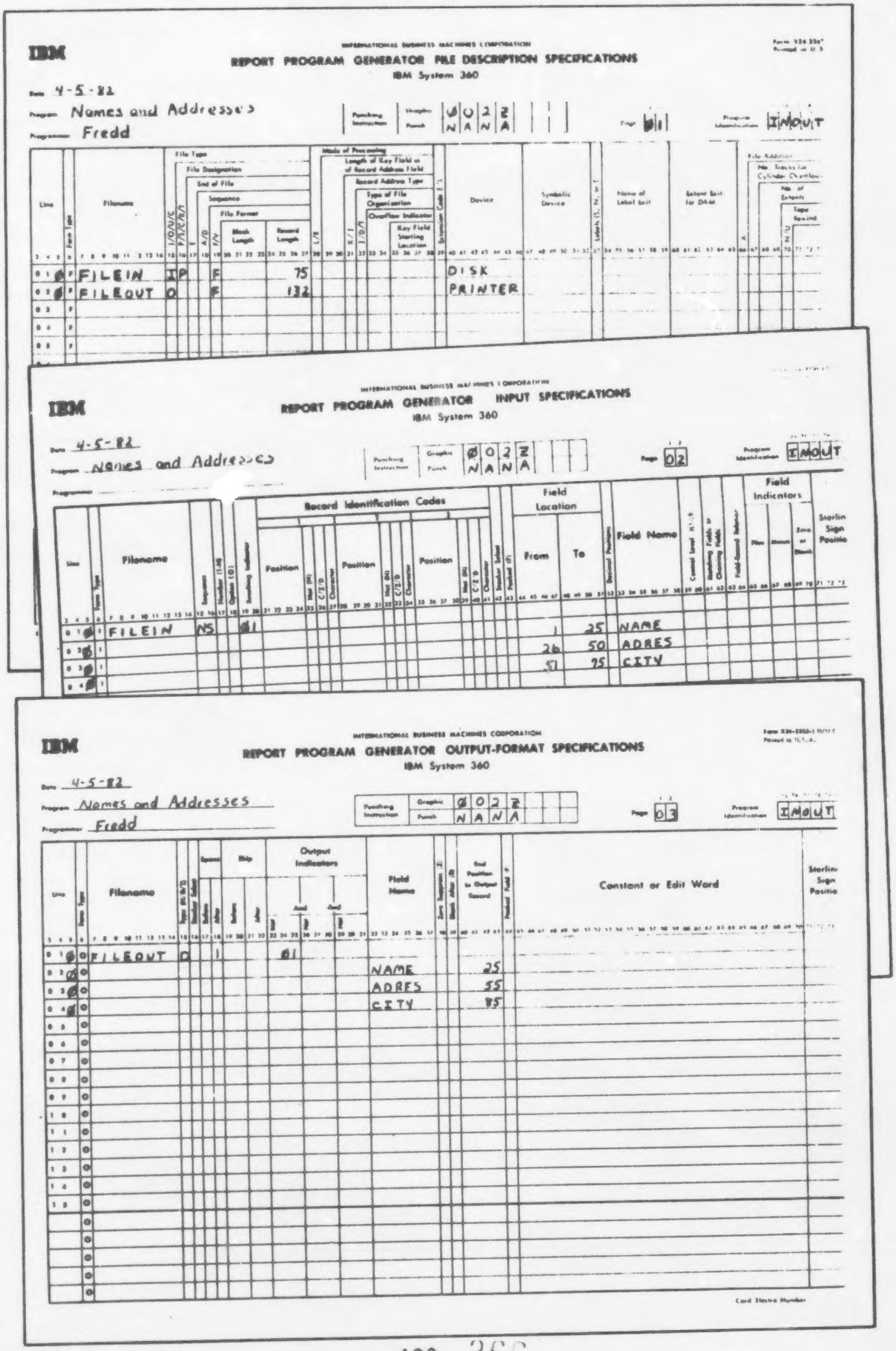

NAME
ADDRESS
CITY/STATE

Output


144/10/6 PRINT CHART
PROG ID
PAGE
(SPACING: 144 POSITION SPAN, AT 10 CHARACTERS PER INCH, 6 LINES PER VERTICAL INCH)
DATE
PROGRAM TITLE
PROGRAMMER OR DOCUMENTALIST
CHART TITLE
(NAME)
(ADDRESS)
(CITY/STATE)

```
FREDD, SHARON L.        533 LUNAR        HANNIBAL, MISSOURI
LAMPKIN, TOM            963 MEDIUM       CARROLLTON, MISSOURI
MARSH, DON              411 SPACE        JEFFERSON CITY, MISSOURI
PENNINGTON, T. S.       619 NEW          OSAGE, MISSOURI
PENNISTON, MARY         826 OLD          COLUMBIA, MISSOURI
```

365



IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

REPORT PROGRAM GENERATOR FILE DESCRIPTION SPECIFICATIONS

IBM System 360

Date 4-5-82

Program Names and Addresses

Programmer Fredd

Punching Instruction	Graphic	0	0	2	Z
	Punch	N	A	N	A

Page 01 Program Identification IMOUT

Line	Form Type	Filename	File Type	File Designation	End of File	Sequence	File Format	Block Length	Record Length	Device
01 0	F	FILEIN	I	P			F		75	DISK
02 0	F	FILEOUT	O				F		132	PRINTER
03	F									
04	F									
05	F									

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

REPORT PROGRAM GENERATOR INPUT SPECIFICATIONS

IBM System 360

Date 4-5-82

Program Names and Addresses

Programmer

Punching Instruction	Graphic	0	0	2	Z
	Punch	N	A	N	A

Page 02 Program Identification IMOUT

Line	Form Type	Filename	Sequence	Resulting Indicator	Field Location From	Field Location To	Field Name
01 0	I	FILEIN	NS	01			
02 0	I				1	25	NAME
03 0	I				26	50	ADRES
04 0	I				51	75	CITY

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

IBM System 360

Date 4-5-82

Program Names and Addresses

Programmer Fredd

Punching Instruction	Graphic	0	0	2	Z
	Punch	N	A	N	A

Page 03 Program Identification IMOUT

Line	Form Type	Filename	Type (H/D/T/E)	Space After	Output Indicators	Field Name	End Position in Output Record	Constant or Edit Word
01 0	O	FILEOUT	D	1	01			
02 0	O					NAME	25	
03 0	O					ADRES	55	
04 0	O					CITY	85	
05	O							
06	O							
07	O							
08	O							
09	O							
10	O							
11	O							
12	O							
13	O							
14	O							
15	O							

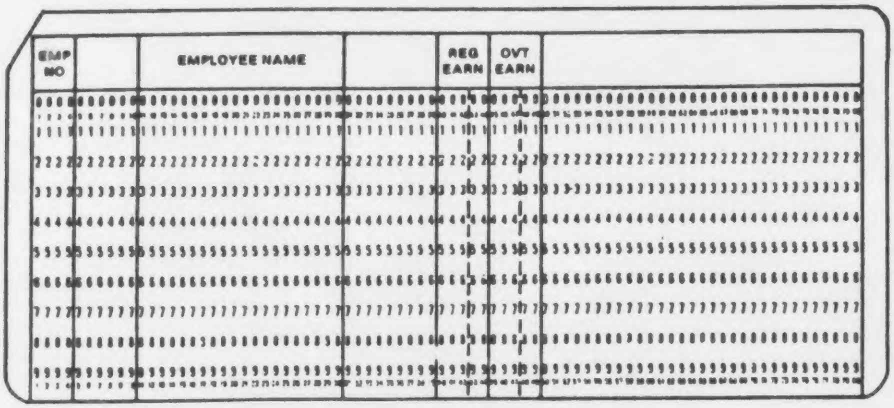
Card Electro Number

RPG COMPUTER PROGRAMMING
UNIT VIII

HANDOUT #2: SAMPLE PROBLEM OF ARITHMETIC OPERATIONS

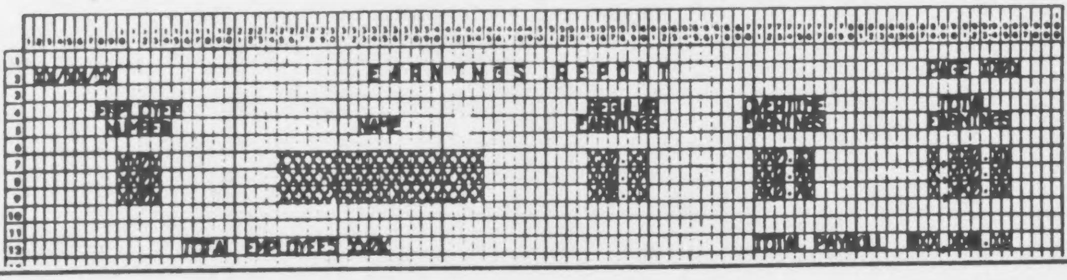
Input in this example consists of the Employee Earnings Cards, containing the Employee Number, Employee Name, Regular Earnings, and Overtime Earnings. Total Earnings are to be calculated by adding Regular Earnings to Overtime Earnings. If there are no Overtime Earnings, the field will contain zeros.

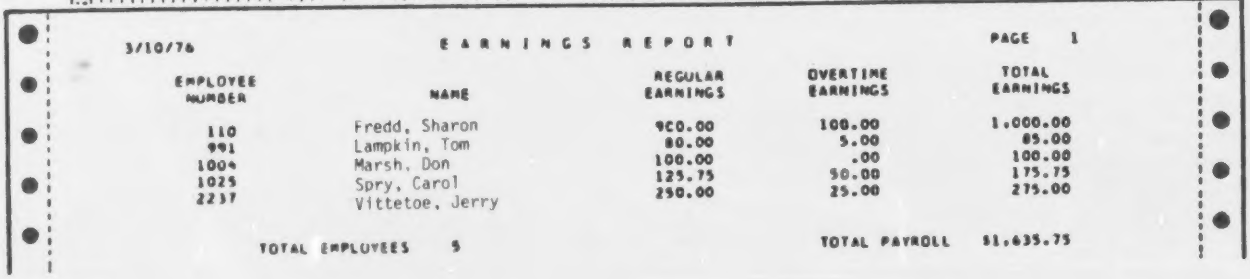
Input


EMP NO
EMPLOYEE NAME
REG EARN
OVT EARN

Output

PRINTER SPACING CHART


EARNINGS REPORT
PAGE
EMPLOYEE NUMBER
NAME
REGULAR EARNINGS
OVERTIME EARNINGS
TOTAL EARNINGS
TOTAL EMPLOYEES
TOTAL PAYROLL



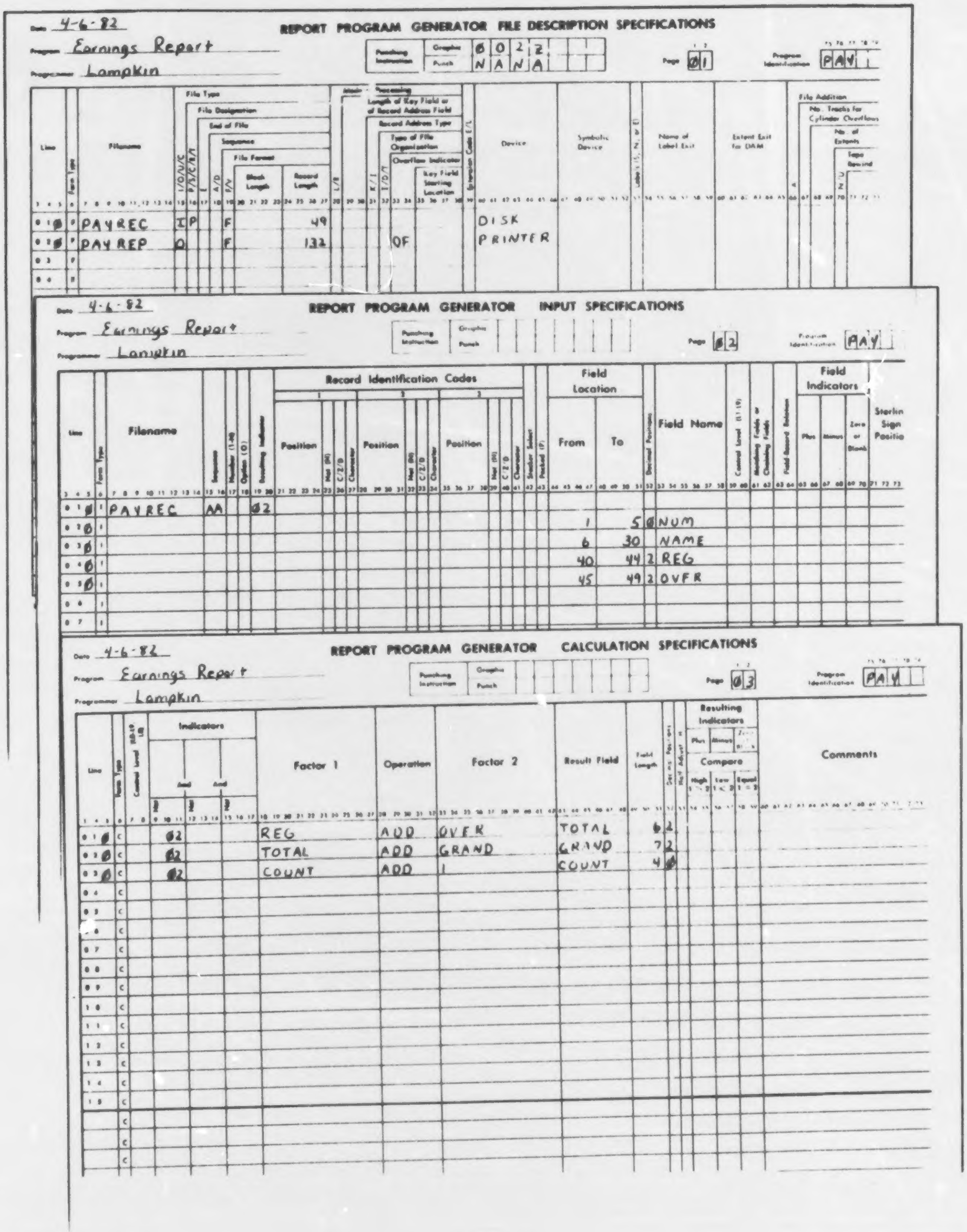
```
3/10/76                         E A R N I N G S   R E P O R T                         PAGE    1

     EMPLOYEE                                        REGULAR        OVERTIME         TOTAL
      NUMBER                 NAME                    EARNINGS       EARNINGS        EARNINGS

        110         Fredd, Sharon                      900.00         100.00        1,000.00
        991         Lampkin, Tom                        80.00           5.00           85.00
       1004         Marsh, Don                         100.00            .00          100.00
       1025         Spry, Carol                        125.75          50.00          175.75
       2237         Vittetoe, Jerry                    250.00          25.00          275.00

           TOTAL EMPLOYEES    5                                 TOTAL PAYROLL    $1,635.75
```

HANDOUT #2 (Cont'd)



REPORT PROGRAM GENERATOR FILE DESCRIPTION SPECIFICATIONS

Date 4-6-82
Program Earnings Report
Programmer Lampkin
Punching Instruction: Graphic 0 0 2 Z; Punch N A N A
Page 01
Program Identification PAY

Line	Form Type	Filename	File Type	File Designation	File Format	Record Length	Overflow Indicator	Device
010	F	PAYREC	I	P	F	49		DISK
010	F	PAYREP	O		F	132	OF	PRINTER
03	F							
04	F							

REPORT PROGRAM GENERATOR INPUT SPECIFICATIONS

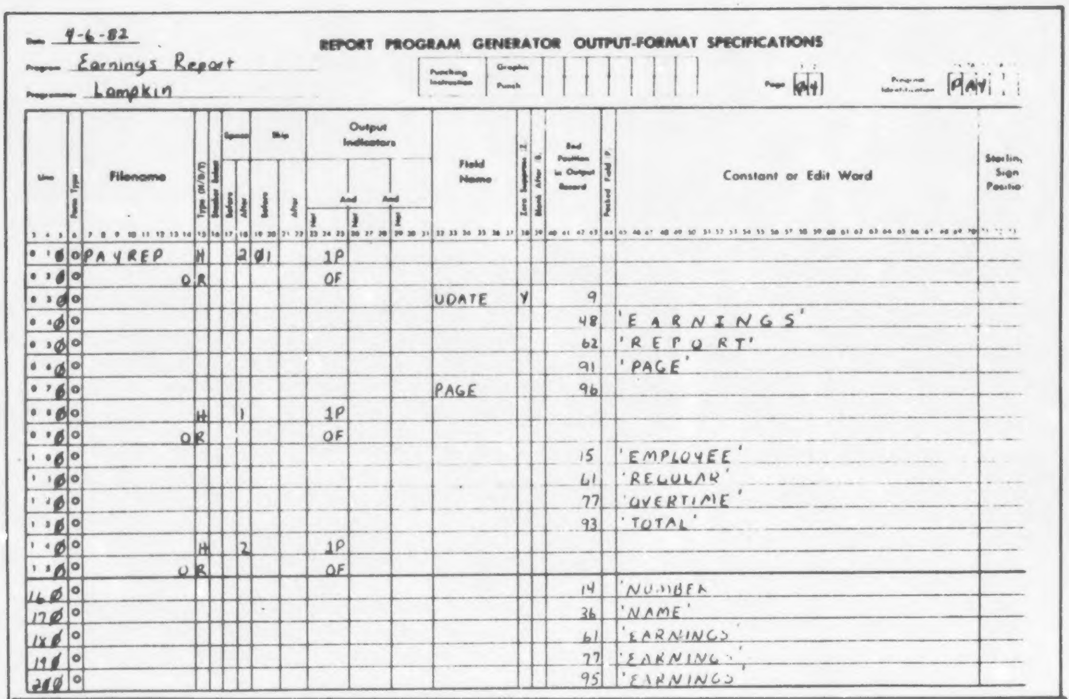
Date 4-6-82
Program Earnings Report
Programmer Lampkin
Page 02
Program Identification PAY

Line	Form Type	Filename	Sequence	Resulting Indicator	Field Location From	Field Location To	Decimal Positions	Field Name
010	I	PAYREC	AA	02				
020	I				1	5	0	NUM
030	I				6	30		NAME
040	I				40	44	2	REG
050	I				45	49	2	OVFR
06	I							
07	I							

REPORT PROGRAM GENERATOR CALCULATION SPECIFICATIONS

Date 4-6-82
Program Earnings Report
Programmer Lampkin
Page 03
Program Identification PAY

Line	Form Type	Indicators	Factor 1	Operation	Factor 2	Result Field	Field Length	Decimal Positions
010	C	02	REG	ADD	OVER	TOTAL	6	2
020	C	02	TOTAL	ADD	GRAND	GRAND	7	2
030	C	02	COUNT	ADD	1	COUNT	4	0
04	C							
05	C							
06	C							
07	C							
08	C							
09	C							
10	C							
11	C							
12	C							
13	C							
14	C							
15	C							
	C							
	C							
	C							



Date 4-6-82

REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

Program Earnings Report

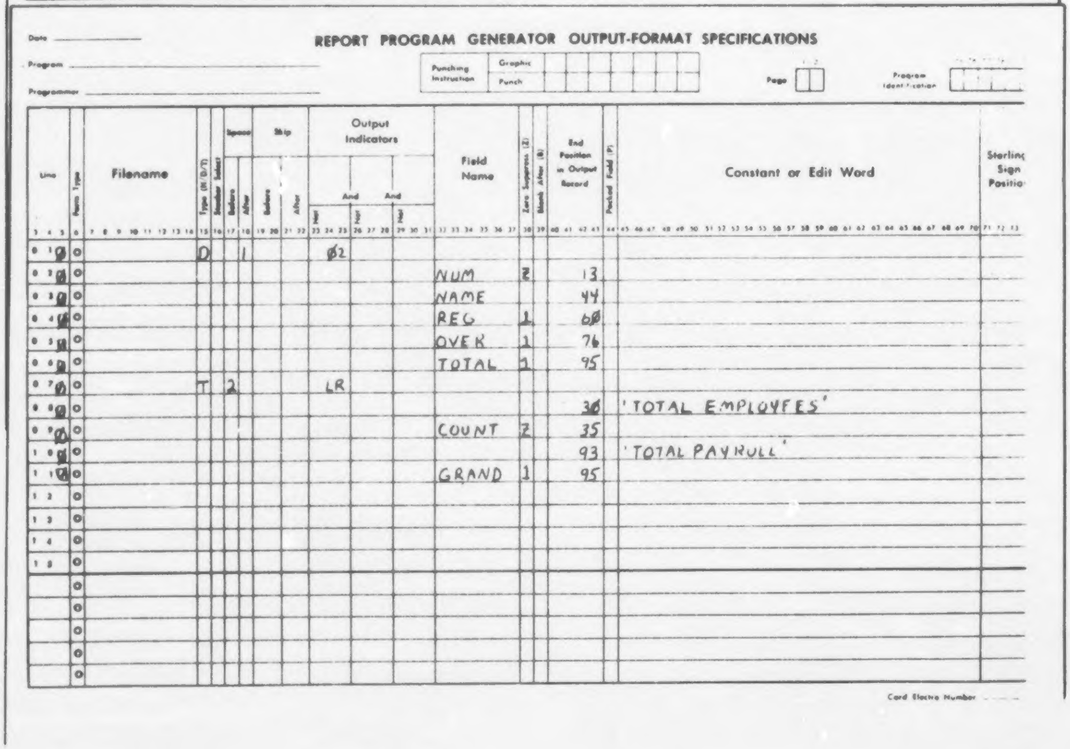
Programmer Lampkin

Punching Instruction: Graphic / Punch

Page 04

Program Identification PAY

Line	Form Type	Filename	Type (H/D/T/E)	Stacker Select	Space Before	Space After	Skip Before	Skip After	Output Indicators	And	And	Field Name	Zero Suppress (Z)	Blank After (B)	End Position in Output Record	Packed Field (P)	Constant or Edit Word	Sterling Sign Position
010	O	PAYREP	H			2	01		1P									
020	O	OR							OF									
030	O											UDATE	Y		9			
040	O														48		'EARNINGS'	
050	O														62		'REPORT'	
060	O														91		'PAGE'	
070	O											PAGE			96			
080	O		H			1			1P									
090	O	OR							OF									
100	O														15		'EMPLOYEE'	
110	O														61		'REGULAR'	
120	O														77		'OVERTIME'	
130	O														93		'TOTAL'	
140	O		H			2			1P									
150	O	OR							OF									
160	O														14		'NUMBER	
170	O														36		'NAME'	
180	O														61		'EARNINGS'	
190	O														77		'EARNINGS'	
200	O														95		'EARNINGS'	



Date

REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

Program

Programmer

Punching Instruction: Graphic / Punch

Page

Program Identification

Line	Form Type	Filename	Type (H/D/T/E)	Stacker Select	Space Before	Space After	Skip Before	Skip After	Output Indicators	And	And	Field Name	Zero Suppress (Z)	Blank After (B)	End Position in Output Record	Packed Field (P)	Constant or Edit Word	Sterling Sign Position
010	O		D			1			02									
020	O											NUM	Z		13			
030	O											NAME			44			
040	O											REG	1		60			
050	O											OVER	1		76			
060	O											TOTAL	1		95			
070	O		T		2				LR									
080	O														30		'TOTAL EMPLOYEES'	
090	O											COUNT	Z		35			
100	O														93		'TOTAL PAYROLL'	
110	O											GRAND	1		95			
12	O																	
13	O																	
14	O																	
15	O																	
	O																	
	O																	
	O																	
	O																	
	O																	

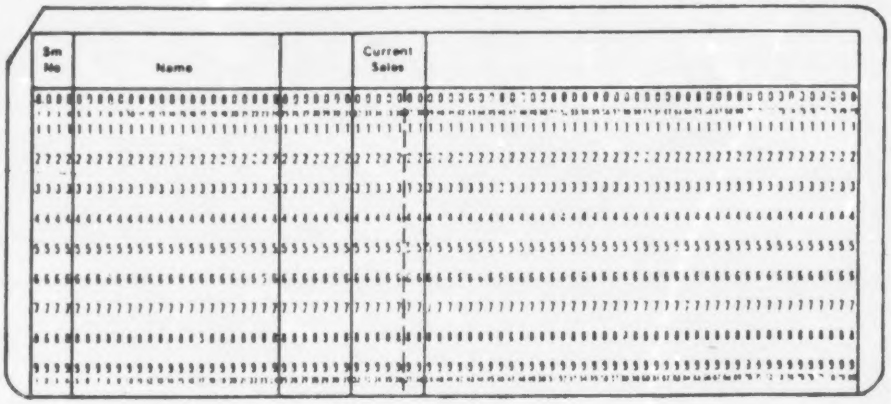
Card Electro Number

369

HANDOUT #3: SAMPLE PROBLEM OF COMPARISON AND MULTIPLY OPERATIONS

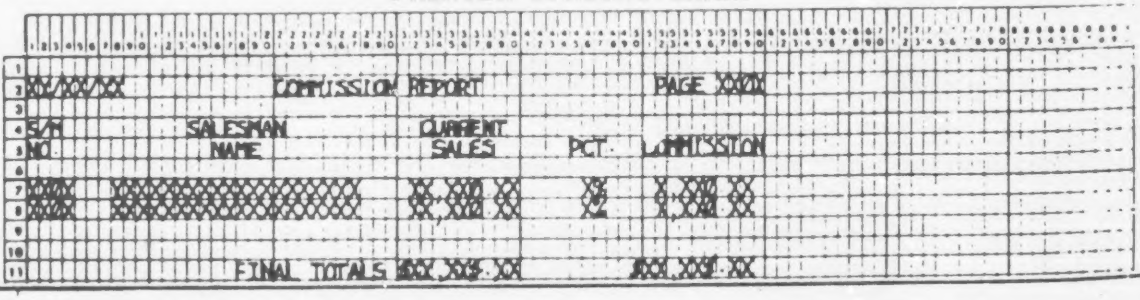
The sample program illustrates the use of the Comparison and Multiply operations. In this problem, a sales commission report is to be prepared. The input to the program is a file of Sales Cards containing the Salesman's Number, the Salesman's Name, and the Current Sales by the salesman. The format of the card is illustrated below.

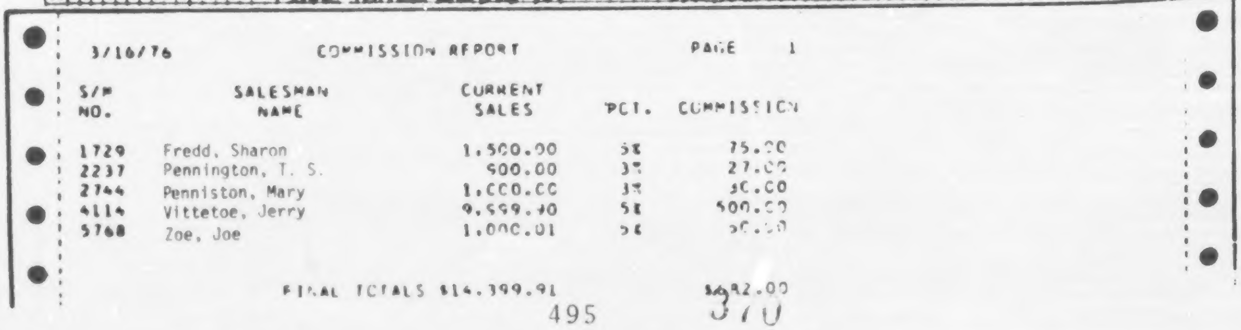
Input:


Sm No
Name
Current Sales

Note in the example above that the input card contains a Salesman's Number field, a Salesman's Name field, and a Current Sales field. The printed report is to contain the Salesman's Number, the Salesman's Name, the Sales, the Percentage of Commission, and the Actual Commission. The percentage of commission is determined as follows: If the Sales in the input card is greater than $1,000, then the percentage of commission is 5%. If the Sales are equal to or less than $1,000, then the percentage of commission is 3%. The Salesman's commission is then computed by multiplying the commission percentage by the Sales. In addition, final totals are taken for the current sales and the total commissions paid. The report is illustrated below.

PRINTER SPACING CHART


1
2 XX/XX/XX COMMISSION REPORT PAGE XXXX
3
4 S/M SALESMAN CURRENT
5 NO. NAME SALES PCT. COMMISSION
6
7 XXXX XXXXXXXXXXXXXXXXXXXX X,XXX.XX X% X,XXX.XX
8
9
10
11 FINAL TOTALS XXX,XXX.XX XXX,XXX.XX

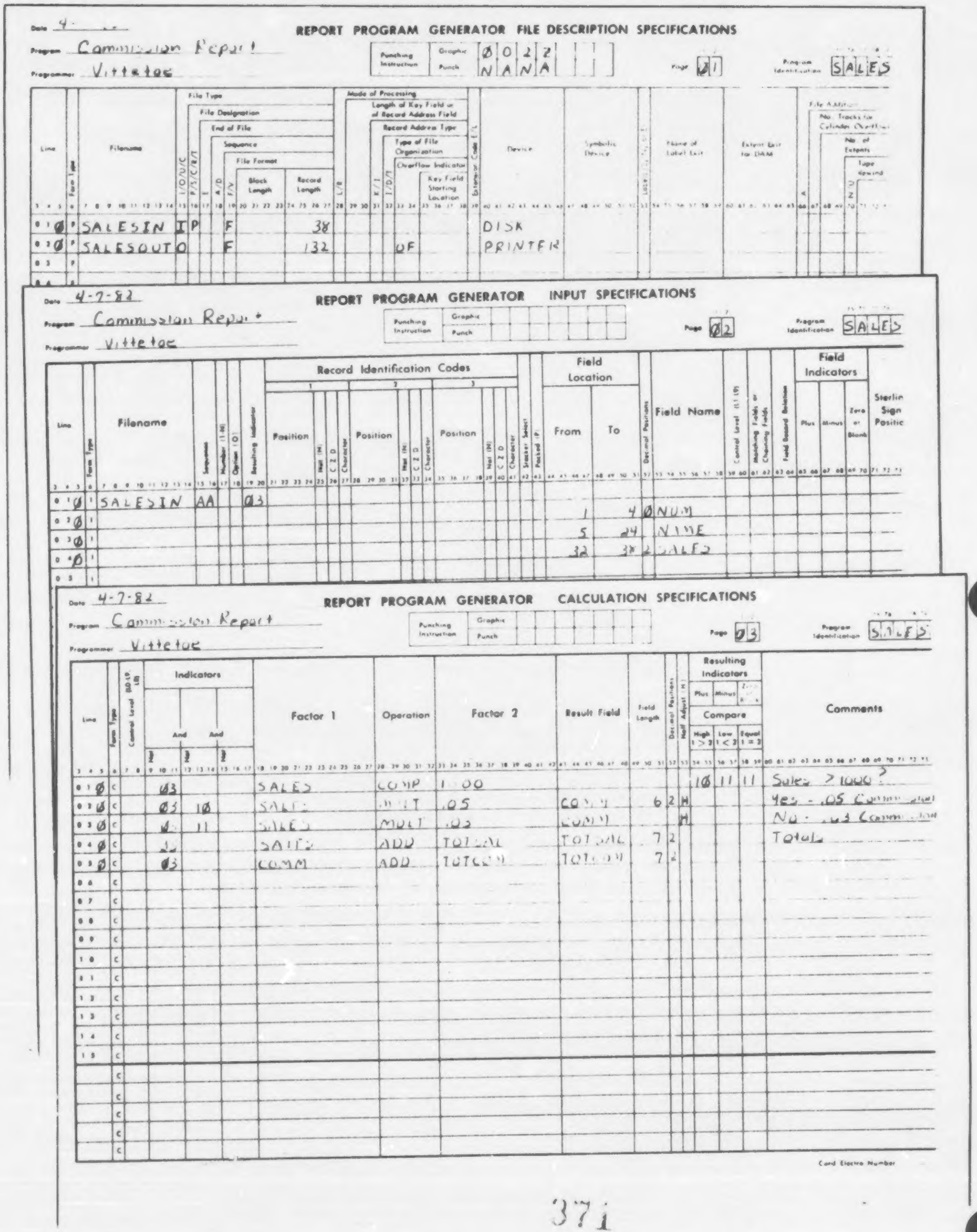


```
3/16/76              COMMISSION REPORT               PAGE    1

S/M            SALESMAN               CURRENT
NO.              NAME                  SALES    PCT.  COMMISSION

1729    Fredd, Sharon                1,500.00    5%       75.00
2237    Pennington, T. S.              900.00    3%       27.00
2744    Penniston, Mary              1,000.00    3%       30.00
4114    Vittetoe, Jerry              9,999.90    5%      500.00
5768    Zoe, Joe                     1,000.01    5%       50.00

                   FINAL TOTALS $14,399.91              $682.00
```



REPORT PROGRAM GENERATOR FILE DESCRIPTION SPECIFICATIONS

Date 4-

Program Commission Report

Programmer Vittetoe

Punching Instruction: Graphic 0 0 2 Z / Punch N A N A

Page 01

Program Identification SALES

Line	Form Type	Filename	File Type	File Designation	End of File	Sequence	File Format	Block Length	Record Length	Overflow Indicator	Device
010	F	SALESIN	I	P			F		38		DISK
020	F	SALESOUT	O				F		132	OF	PRINTER
03	F										

REPORT PROGRAM GENERATOR INPUT SPECIFICATIONS

Date 4-7-82

Program Commission Report

Programmer Vittetoe

Page 02

Program Identification SALES

Line	Form Type	Filename	Sequence	Number (1-N)	Option (O)	Resulting Indicator	Field Location From	Field Location To	Decimal Positions	Field Name
010	I	SALESIN	AA			03				
020	I						1	4	0	NUM
030	I						5	24		NAME
040	I						32	38	2	SALES
05	I									

REPORT PROGRAM GENERATOR CALCULATION SPECIFICATIONS

Date 4-7-82

Program Commission Report

Programmer Vittetoe

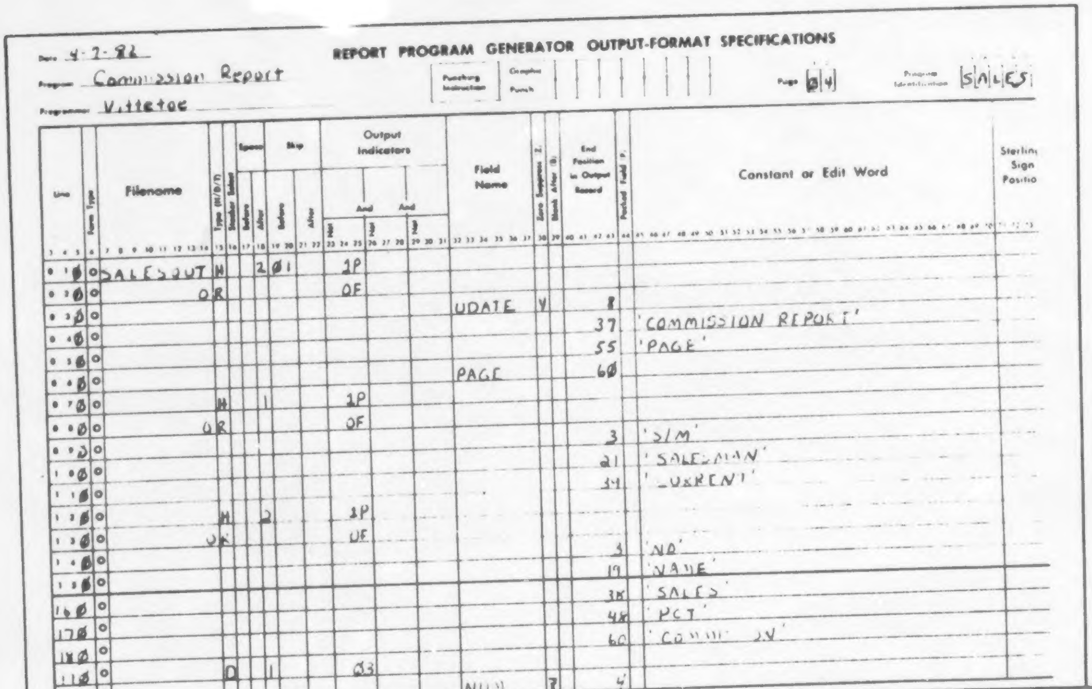
Page 03

Program Identification SALES

Line	Form Type	Control Level	Indicators	And	And	Factor 1	Operation	Factor 2	Result Field	Field Length	Decimal Positions	Half Adjust (H)	Resulting Indicators High 1 > 2	Low 1 < 2	Equal 1 = 2	Comments
010	C		03			SALES	COMP	1000					10	11	11	Sales > 1000?
020	C		03	10		SALES	MULT	.05	COMM	6	2	H				Yes - .05 Commission
030	C		03	11		SALES	MULT	.03	COMM			H				No - .03 Commission
040	C		03			SALES	ADD	TOTSAL	TOTSAL	7	2					Totals
050	C		03			COMM	ADD	TOTCOM	TOTCOM	7	2					
06	C															
07	C															
08	C															
09	C															
10	C															
11	C															
12	C															
13	C															
14	C															
15	C															

Card Electro Number

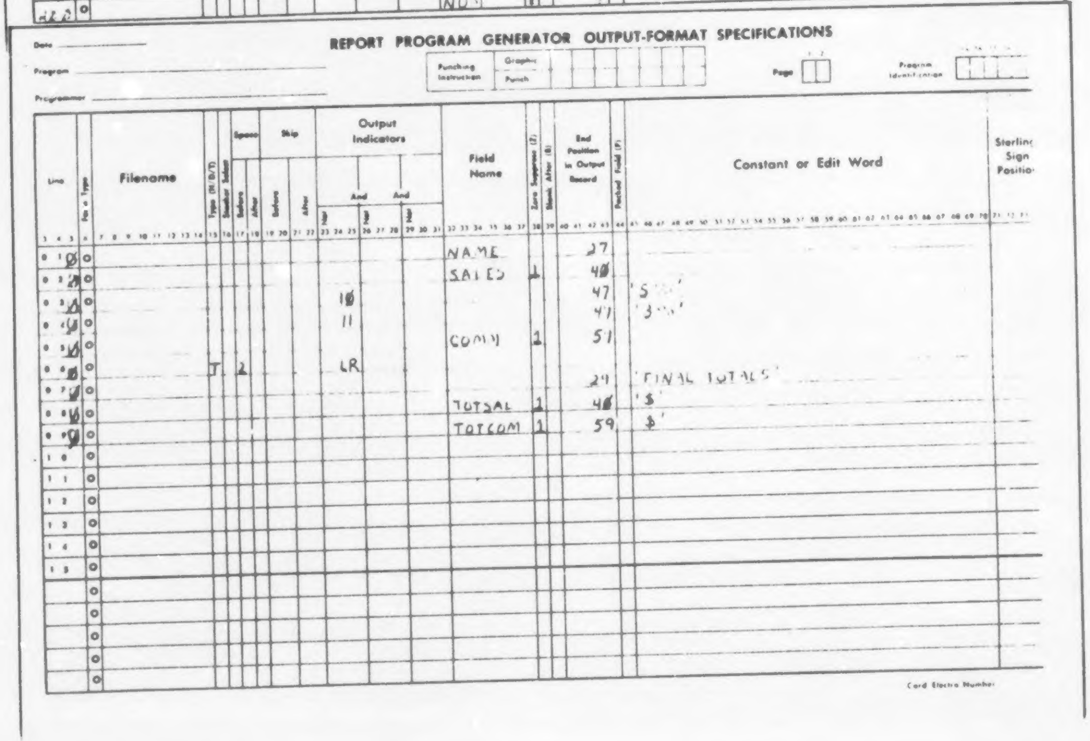
HANDOUT #3 (Cont'd)



REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

Date 4-7-82
Program Commission Report
Programmer Vittetoe
Punching Instruction: Graphic / Punch
Page 04
Program Identification SALES

Line	Form Type	Filename	Type (H/D/T/E)	Stacker Select	Space Before	Space After	Skip Before	Skip After	Output Indicators	And	And	Field Name	Zero Suppress (Z)	Blank After (B)	End Position in Output Record	Packed Field (P)	Constant or Edit Word	Sterling Sign Position
010	O	SALESOUT	H			2	01		1P									
020	O		OR						OF									
030	O											UDATE	Y		8			
040	O														37		'COMMISSION REPORT'	
050	O														55		'PAGE'	
060	O											PAGE			60			
070	O		H			1			1P									
080	O		OR						OF									
090	O														3		'S/M'	
100	O														21		'SALESMAN'	
110	O														34		'CURRENT'	
120	O		H			2			1P									
130	O		OR						OF									
140	O														3		'NO'	
150	O														19		'NAME'	
160	O														38		'SALES'	
170	O														48		'PCT'	
180	O														60		'COMMISSION'	
190	O		D			1			03									
[illegible]	O											NUM	Z		4			



REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

Date
Program
Programmer
Punching Instruction: Graphic / Punch
Page
Program Identification

Line	Form Type	Filename	Type (H/D/T/E)	Stacker Select	Space Before	Space After	Skip Before	Skip After	Output Indicators	And	And	Field Name	Zero Suppress (Z)	Blank After (B)	End Position in Output Record	Packed Field (P)	Constant or Edit Word	Sterling Sign Position
010	O											NAME			27			
020	O											SALES	1		40			
030	O								10						47		'5 [illegible]'	
040	O								11						47		'3 [illegible]'	
050	O											COMM	1		51			
060	O		T		2				LR									
070	O														29		'FINAL TOTALS'	
080	O											TOTSAL	1		40		'$'	
090	O											TOTCOM	1		59		'$'	
10	O																	
11	O																	
12	O																	
13	O																	
14	O																	
15	O																	

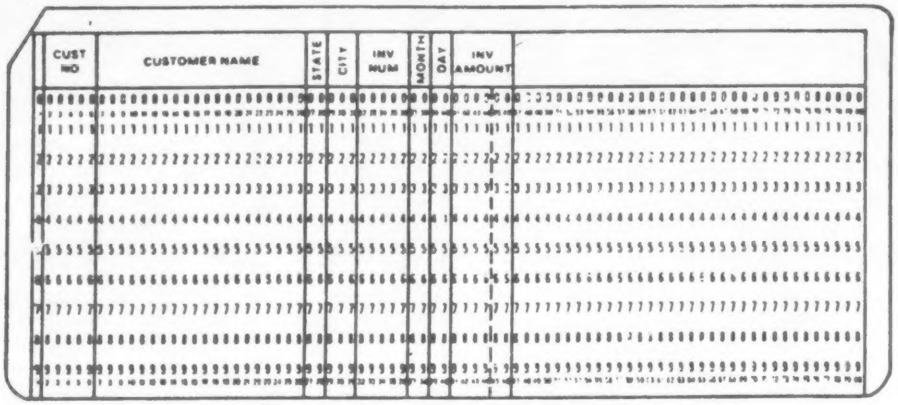
Card Electro Number

RPG COMPUTER PROGRAMMING
UNIT VIII

HANDOUT #4: SAMPLE PROBLEM OF CONTROL BREAKS

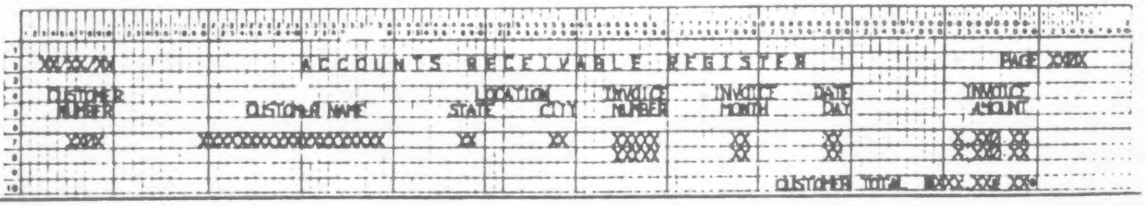
This is an illustration of the input, output, and program of the sample problem to produce a group indicated report.

Input



Output

PRINTER SPACING CHART

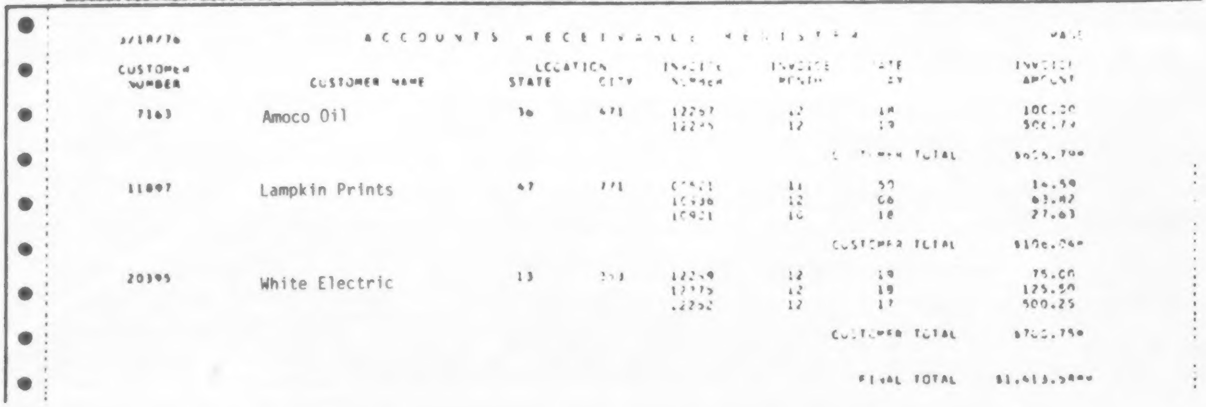


```
XX/XX/XX            ACCOUNTS RECEIVABLE REGISTER                        PAGE XXXX

CUSTOMER                               LOCATION     INVOICE   INVOICE   DATE       INVOICE
 NUMBER           CUSTOMER NAME      STATE   CITY   NUMBER    MONTH     DAY        AMOUNT

  XXXX       XXXXXXXXXXXXXXXXXXXX     XX      XX    XXXXX      XX       XX        X,XXX.XX
                                                    XXXXX      XX       XX        X,XXX.XX

                                                         CUSTOMER TOTAL   $XX,XXX.XX*
```



```
3/18/76             ACCOUNTS RECEIVABLE REGISTER                        PAGE

CUSTOMER                               LOCATION     INVOICE   INVOICE   DATE       INVOICE
 NUMBER           CUSTOMER NAME      STATE   CITY   NUMBER    MONTH     DAY        AMOUNT

  7163       Amoco Oil                36     471    12257      12       18         100.00
                                                    12245      12       19         505.79

                                                         CUSTOMER TOTAL          $605.79*

 11897       Lampkin Prints           47     771    09521      11       30          14.59
                                                    10536      12       06          63.82
                                                    10921      10       10          27.63

                                                         CUSTOMER TOTAL          $106.04*

 20395       White Electric           13     353    12249      12       19          75.00
                                                    12275      12       19         125.50
                                                    12252      12       17         500.25

                                                         CUSTOMER TOTAL          $700.75*

                                                         FINAL TOTAL          $1,413.58**
```

REPORT PROGRAM GENERATOR FILE DESCRIPTION SPECIFICATIONS

Date 4-8-82
Program Accounts Receivables
Programmer Penniston
Punching Instruction: Graphic Ø O 2 Z; Punch N A N A
Page 01
Program Identification REC

Line	Form Type	Filename	File Type	File Designation	End of File	Sequence	File Format	Block Length	Record Length	Overflow Indicator	Device
010	F	CUSTOMER	I	P			F		46		DISK
020	F	ACCOUNTS	O				F		132	OF	PRINTER

REPORT PROGRAM GENERATOR INPUT SPECIFICATIONS

Date 4-8-82
Program Accounts Receivables
Programmer Penniston
Page 02
Program Identification REC

Line	Form Type	Filename	Sequence	Resulting Indicator	Field Location From	Field Location To	Decimal Positions	Field Name	Control Level (L1-L9)
010	I	CUSTOMER	AA	04					
020	I				2	6	0	NUM	L1
030	I				7	26		NAME	
040	I				27	28		STATE	
050	I				29	31		CITY	
060	I				32	36		INVNUM	
070	I				37	38		MONTH	
080	I				39	40		DAY	
090	I				41	46	2	AMOUNT	

REPORT PROGRAM GENERATOR CALCULATION SPECIFICATIONS

Date 4-8-82
Program Accounts Receivables
Programmer Penniston
Page 03
Program Identification REC

Line	Form Type	Control Level	Indicators	Factor 1	Operation	Factor 2	Result Field	Field Length	Decimal Positions
010	C		01	AMOUNT	ADD	CUSTOT	CUSTOT	8	2
020	C	L1		CUSTOT	ADD	FINAL	FINAL	8	2

REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

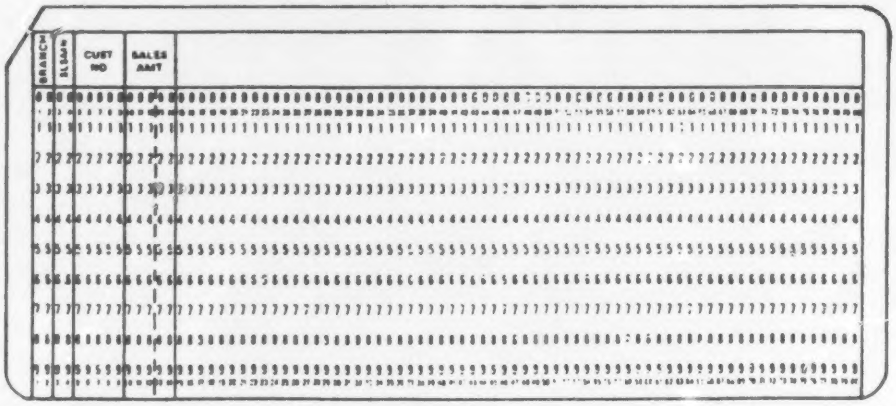
Date 4-8-82
Program Accounts Receivables
Programmer Penniston
Page 04
Program Identification R[illegible]

Line	Form Type	Filename	Type (H/D/T)	Space Before	Space After	Output Indicators	Field Name	Zero Suppress (Z)	Blank After (B)	End Position in Output Record	Constant or Edit Word
010	O	ACCOUNTS	D		1	04					
020	O						NUM	Z		9	
030	O						NAME			34	
040	O						STATE			49	
050	O						CITY			59	
060	O						INVNUM			69	
070	O						MONTH			79	
080	O						DAY			89	
090	O						AMOUNT	1		109	
100	O		T	1	2	L1					
110	O									96	'CUSTOMER TOTAL'
120	O						CUSTOT	1	B	109	'$'
130	O									110	'#'
140	O		T	1		LR					
150	O									96	'FINAL TOTAL'
160	O						FINAL			104	'$'
170	O									111	'##'

RPG COMPUTER PROGRAMMING
UNIT VIII

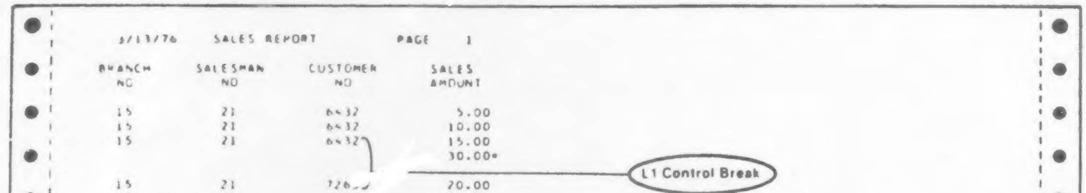
HANDOUT #5: SAMPLE PROBLEM OF MULTIPLE CONTROL BREAKS

Card Input



Note in the card format illustrated above that the sales card consists of a Branch Number, a Salesman's Number, a Customer's Number, and a Sales Amount. A Sales Report is to be prepared which uses the Branch Number, the Salesman's Number, and the Customer Number as control fields.

Output:


L1 Control Break
L2 Control Break
L3 Control Break

```
  3/13/76     SALES REPORT          PAGE    1

  BRANCH      SALESMAN     CUSTOMER      SALES
    NO           NO           NO         AMOUNT

    15           21          6432          5.00
    15           21          6432         10.00
    15           21          6432         15.00
                                          30.00*

    15           21          7263         20.00
    15           21          7263         10.00
                                          30.00*

    15           21         11697        500.00
                                         500.00*

                           TOTAL SALESMAN NO 21   560.00**

    15           79         11697        100.00
    15           79         11697         60.00
                                         160.00*

    15           79          7163          5.00
                                           5.00*

                           TOTAL SALESMAN NO 79   165.00**
                                 TOTAL BRANCH NO 15      725.00 ***

    39           12          7163          7.50
    39           12          7163         90.00
                                          97.50*

    39           12         11699        200.00
                                         200.00*

                           TOTAL SALESMAN NO 12   297.50**

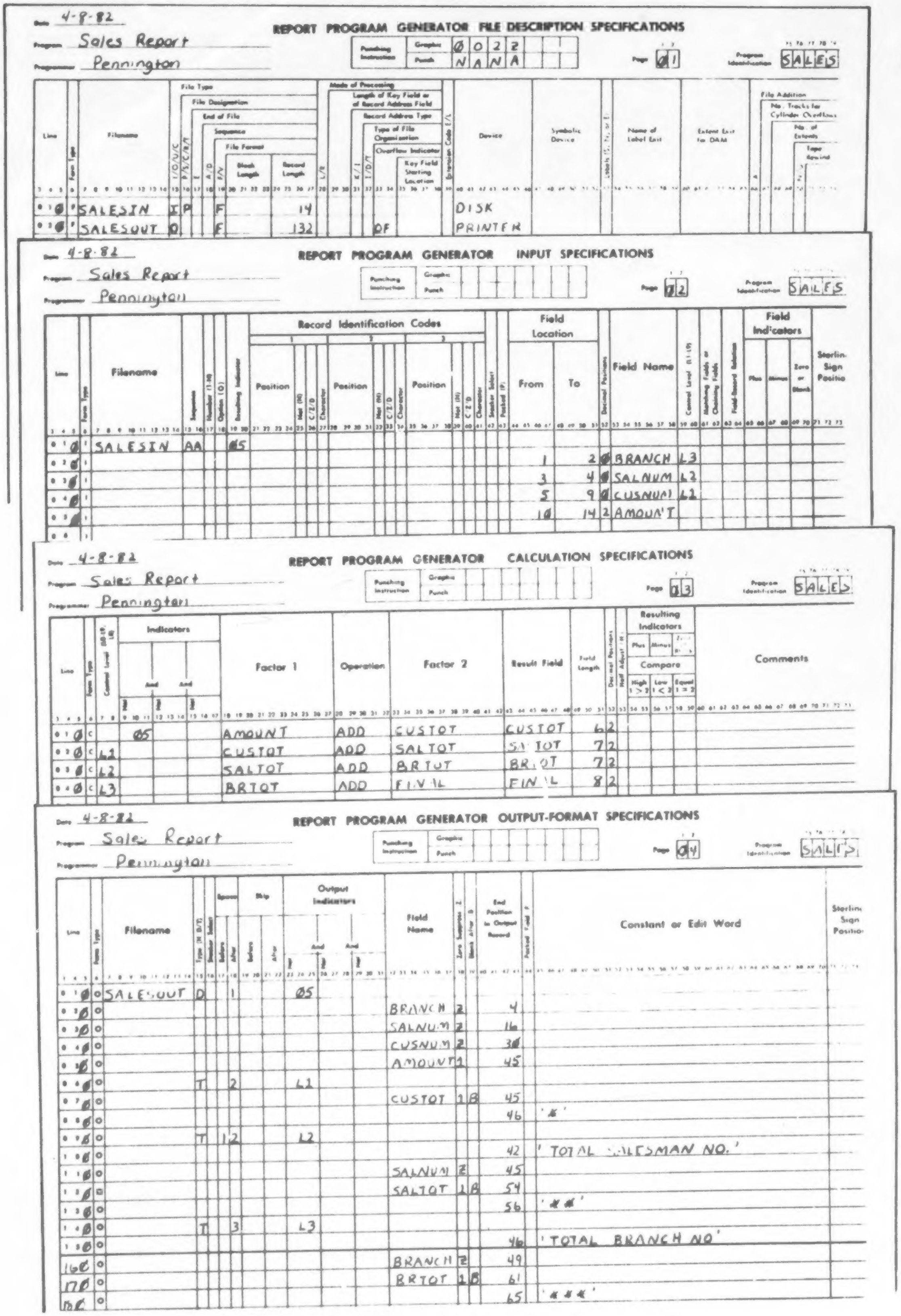
    39           56         11697        150.00
                                         150.00*

    39           56          6432        175.00
                                         175.00*

                           TOTAL SALESMAN NO 56   325.00**
                                 TOTAL BRANCH NO 39      622.50 ***

                                 FINAL TOTAL    [illegible] ****
```

HANDOUT #5 (Cont'd)



Date 4-8-82

REPORT PROGRAM GENERATOR FILE DESCRIPTION SPECIFICATIONS

Program Sales Report

Programmer Pennington

Punching Instruction: Graphic Ø 0 2 Z; Punch N A N A

Page Ø1 Program Identification SALES

Line	Form Type	Filename	File Type	File Designation	End of File	Sequence	File Format	Block Length	Record Length	Overflow Indicator	Device
01Ø	F	SALESIN	I	P			F		14		DISK
02Ø	F	SALESOUT	O				F		132	OF	PRINTER

Date 4-8-82

REPORT PROGRAM GENERATOR INPUT SPECIFICATIONS

Program Sales Report

Programmer Pennington

Page Ø2 Program Identification SALES

Line	Form Type	Filename	Sequence	Resulting Indicator	Field Location From	Field Location To	Decimal Positions	Field Name	Control Level (L1-L9)
01Ø	I	SALESIN	AA	Ø5					
02Ø	I				1	2	Ø	BRANCH	L3
03Ø	I				3	4	Ø	SALNUM	L2
04Ø	I				5	9	Ø	CUSNUM	L1
05Ø	I				1Ø	14	2	AMOUNT	
06	I								

Date 4-8-82

REPORT PROGRAM GENERATOR CALCULATION SPECIFICATIONS

Program Sales Report

Programmer Pennington

Page Ø3 Program Identification SALES

Line	Form Type	Control Level	Indicators	Factor 1	Operation	Factor 2	Result Field	Field Length	Decimal Positions
01Ø	C		Ø5	AMOUNT	ADD	CUSTOT	CUSTOT	6	2
02Ø	C	L1		CUSTOT	ADD	SALTOT	SALTOT	7	2
03Ø	C	L2		SALTOT	ADD	BRTOT	BRTOT	7	2
04Ø	C	L3		BRTOT	ADD	FINAL	FINAL	8	2

Date 4-8-82

REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

Program Sales Report

Programmer Pennington

Page Ø4 Program Identification SALES

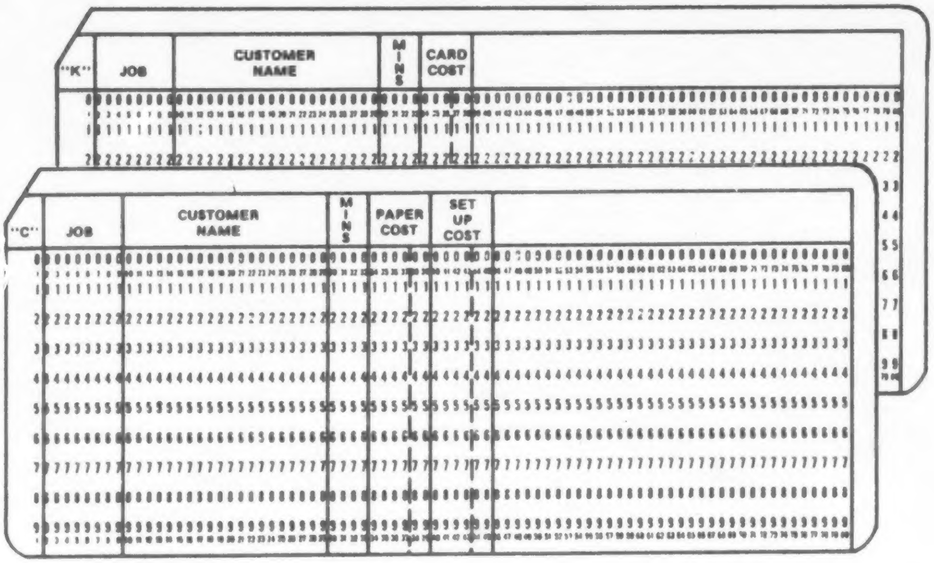
Line	Form Type	Filename	Type (H/D/T/E)	Space Before	Space After	Output Indicators	Field Name	Zero Suppress	Blank After	End Position in Output Record	Constant or Edit Word
01Ø	O	SALESOUT	D		1	Ø5					
02Ø	O						BRANCH	Z		4	
03Ø	O						SALNUM	Z		16	
04Ø	O						CUSNUM	Z		3Ø	
05Ø	O						AMOUNT	1		45	
06Ø	O		T		2	L1					
07Ø	O						CUSTOT	1	B	45	
08Ø	O									46	'*'
09Ø	O		T	1	2	L2					
10Ø	O									42	'TOTAL SALESMAN NO.'
11Ø	O						SALNUM	Z		45	
12Ø	O						SALTOT	1	B	54	
13Ø	O									56	'**'
14Ø	O		T		3	L3					
15Ø	O									46	'TOTAL BRANCH NO'
16Ø	O						BRANCH	Z		49	
17Ø	O						BRTOT	1	B	61	
18Ø	O									65	'***'

RPG COMPUTER PROGRAMMING
UNIT VIII

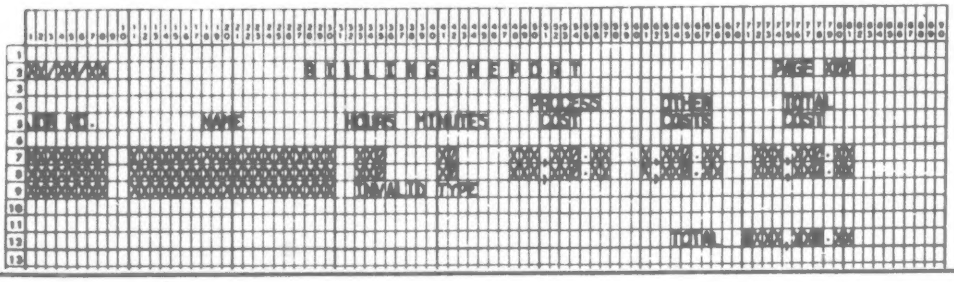
HANDOUT #6: SAMPLE PROBLEM OF MULTIPLE RECORD TYPES

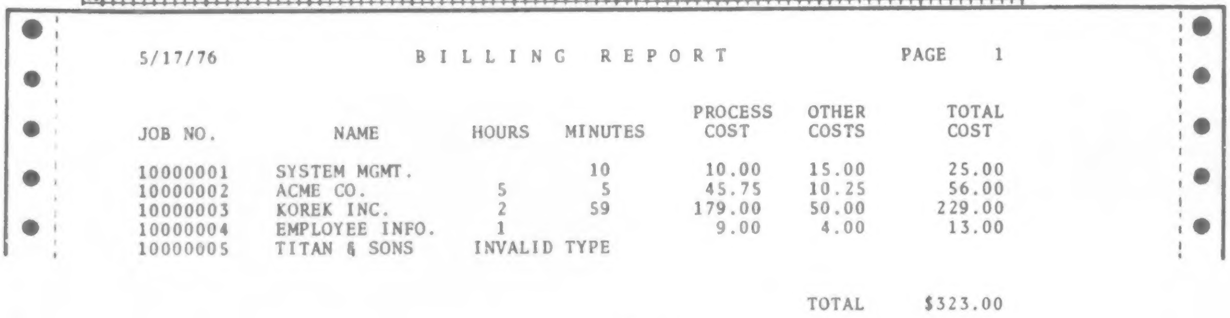
This sample program creates a Billing Report. The input to the program and the output from the program are illustrated below.

Input


"K"
JOB
CUSTOMER NAME
MINS
CARD COST
"C"
JOB
CUSTOMER NAME
MINS
PAPER COST
SET UP COST

Output


XX/XX/XX
BILLING REPORT
PAGE XXX
JOB NO.
NAME
HOURS
MINUTES
PROCESS COST
OTHER COSTS
TOTAL COST
INVALID TYPE
TOTAL



```
5/17/76                   B I L L I N G   R E P O R T             PAGE    1

                                                     PROCESS   OTHER       TOTAL
JOB NO.          NAME            HOURS   MINUTES      COST     COSTS       COST

10000001  SYSTEM MGMT.                      10        10.00    15.00       25.00
10000002  ACME CO.                 5         5        45.75    10.25       56.00
10000003  KOREK INC.               2        59       179.00    50.00      229.00
10000004  EMPLOYEE INFO.           1                   9.00     4.00       13.00
10000005  TITAN & SONS        INVALID TYPE

                                                              TOTAL    $323.00
```

REPORT PROGRAM GENERATOR FILE DESCRIPTION SPECIFICATIONS

Date 4-9-82
Program Billing Report
Programmer Marsh

Punching Instruction	Graphic	0 0 2 Z	
	Punch	N A N A	

Page 01
Program Identification BILL

Line	Filename	File Type	File Designation	File Format	Record Length	Device
01 0	BILLIN	I	P	F	45	DISK
02 0	BILLOUT	O		F	132	PRINTER

REPORT PROGRAM GENERATOR INPUT SPECIFICATIONS

Date 4-9-82
Program Billing Report
Programmer Marsh

Page 02
Program Identification BILL

Line	Filename	Sequence	Resulting Indicator	Position (1)	Not (N) (1)	C/Z/D (1)	Character (1)	Position (2)	Not (N) (2)	C/Z/D (2)	Character (2)	Field Location From	Field Location To	Decimal Positions	Field Name	Field Record Relation
01 0	BILLIN	AA	06	1		C	C									
02 0	OR		07	1		C	K									
03 0	OR		08	1	N	C	C	1	N	C	K					
04 0												2	9		JOB	
05 0												10	29		NAME	
06 0												30	33	0	MIN	
07 0												34	39	2	PAPER	06
08 0												40	45	2	SETUP	06
09 0												34	38	2	CARD	07

REPORT PROGRAM GENERATOR CALCULATION SPECIFICATIONS

Date 4-9-82
Program Billing Report
Programmer Marsh

Page 03
Program Identification BILL

Line	Form Type	Indicators	Factor 1	Operation	Factor 2	Result Field	Field Length	Decimal Positions
01 0	C	06	MIN	MULT	1	COST	8	2
02 0	C	06	PAPER	ADD	SETUP	ADCOST	6	2
03 0	C	06	COST	ADD	ADCOST	TOTCOS	8	2
04 0	C	07	MIN	MULT	.15	COST		
05 0	C	07	CARD	ADD	COST	TOTCOS		
06 0	C	N08	MIN	DIV	60	HRS	3	0
07 0	C	N08		MVR		MINS	2	0
08 0	C	N08	TOTCOS	ADD	FINCOS	FINCOS	8	2

REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

Date 4-9-82
Program Billing Report
Programmer Marsh

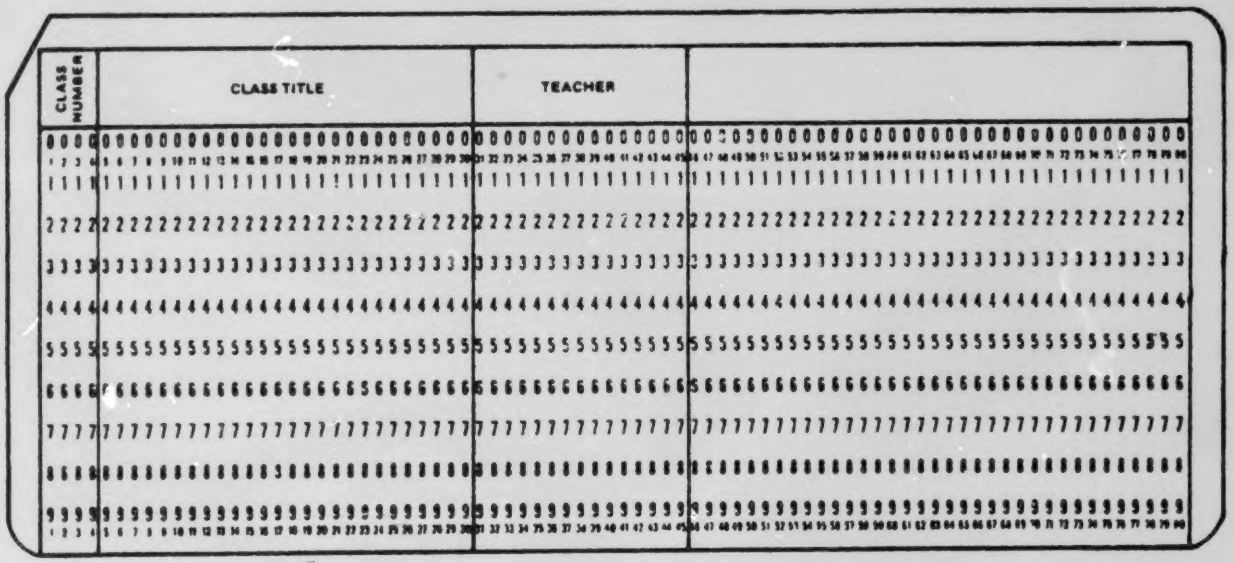
Page 04
Program Identification BILL

Line	Form Type	Filename	Type (H/D/T/E)	Space Before	Space After	Output Indicators	Field Name	Zero Suppress (Z)	End Position in Output Record	Constant or Edit Word
01 0	O	BILLOUT	D		1	06				
02	O	OR				07				
03	O	OR				08				
04	O						JOB		8	
05	O						NAME		30	
06	O					N08	HRS	Z	35	
07	O					N08	MINS	Z	42	
08	O					N08	COST	1	57	
09	O					06	ADCOST	1	68	
10	O					07	TOTCOS	1	68	
11	O					N08	TOTCOS	1	81	
12	O					08			44	'INVALID TYPE'
13	O		T	2		LR				
14	O								68	'TOTAL'
15	O						FINAL	1	81	'$'
	O									
	O									

378

HANDOUT #7: SAMPLE PROBLEM OF EXCEPTION OUTPUT

This sample program illustrates the use of the EXCPT operation in which it is desired to produce 40 Class Registration Cards for each Master record read. Input consists of a Master Class Registration Card containing the Class Number, Class Title, and Teacher. The format is illustrated below.



Output is to consist of 40 punched cards identical in format to the original Master Class Registration Cards.

REPORT PROGRAM GENERATOR FILE DESCRIPTION SPECIFICATIONS

Date 4-10-82
Program Class Registration Cards
Programmer Spry

Punching Instruction: Graphic 0 O 2 Z; Punch N A N A
Page 01
Program Identification CLASS

Line	Form Type	Filename	File Type	File Designation	End of File	Sequence	File Format	Block Length	Record Length	Device
010	F	CLASSIN	I	P			F		45	DISK
020	F	CARDOUT	O				F		96	READER
03	F									
04	F									

REPORT PROGRAM GENERATOR INPUT SPECIFICATIONS

Date 4-10-82
Program Class Cards
Programmer Spry
Page 02
Program Identification CLASS

Line	Form Type	Filename	Sequence	Resulting Indicator	Field Location From	Field Location To	Field Name
010	I	CLASSIN	AA	10			
020	I				1	4	NUM
030	I				5	30	CLASS
040	I				31	45	NAME
05	I						
06	I						
07	I						
08	I						

REPORT PROGRAM GENERATOR CALCULATION SPECIFICATIONS

Date 4-10-82
Program
Programmer Spry
Page 03
Program Identification CLASS

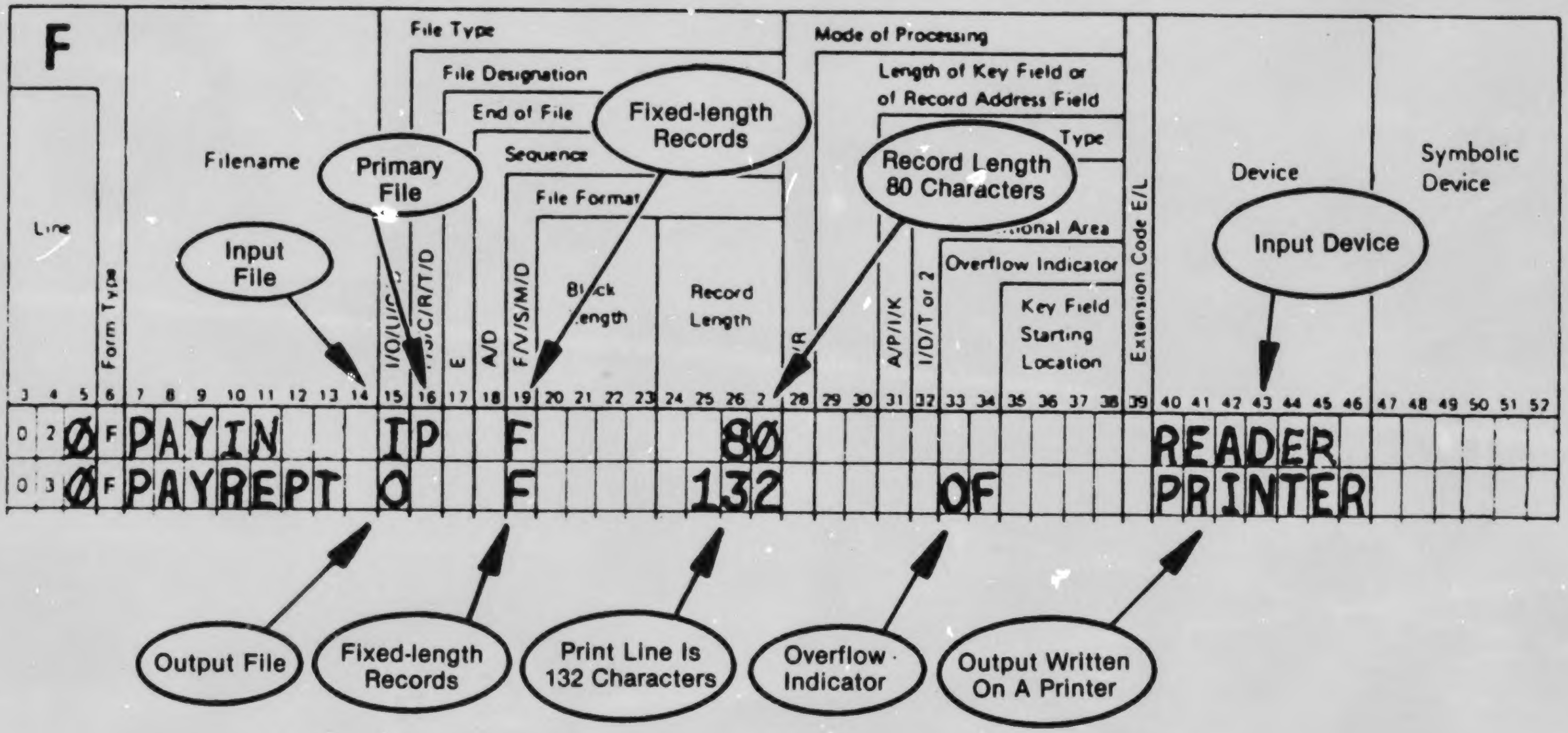
Line	Form Type	Indicators	Factor 1	Operation	Factor 2	Result Field	Field Length	Decimal Positions	Resulting Indicators Equal 1 = 2
010	C		LOOP	TAG					
020	C			EXCPT					
030	C		1	ADD	COUNT	COUNT	2	0	
040	C		COUNT	COMP	40				50
050	C	N50		GOTO	LOOP				
060	C		COUNT	SUB	40	COUNT			
07	C								
08	C								

REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

Date 4-10-82
Program
Programmer Spry
Page 04
Program Identification CLASS

Line	Form Type	Filename	Type (H/D/T/E)	Output Indicators	Field Name	End Position in Output Record
010	O	CARDOUT	E	10		
020	O				NUM	4
030	O				CLASS	30
040	O				NAME	45
05	O					
06	O					
07	O					
08	O					
09	O					
10	O					
11	O					
12	O					
13	O					

File Description Specifications Form


F
Line
Form Type
Filename
File Type
File Designation
End of File
Sequence
File Format
I/O/U/C/D
P/S/C/R/T/D
E
A/D
F/V/S/M/D
Block Length
Record Length
Mode of Processing
Length of Key Field or of Record Address Field
Type
Optional Area
Overflow Indicator
Key Field Starting Location
A/P/I/K
I/D/T or 2
Extension Code E/L
Device
Symbolic Device
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52

0 2 0 F PAYIN IP F 80 READER

0 3 0 F PAYREPT O F 132 OF PRINTER

Input File

Primary File

Fixed-length Records

Record Length 80 Characters

Input Device

Output File

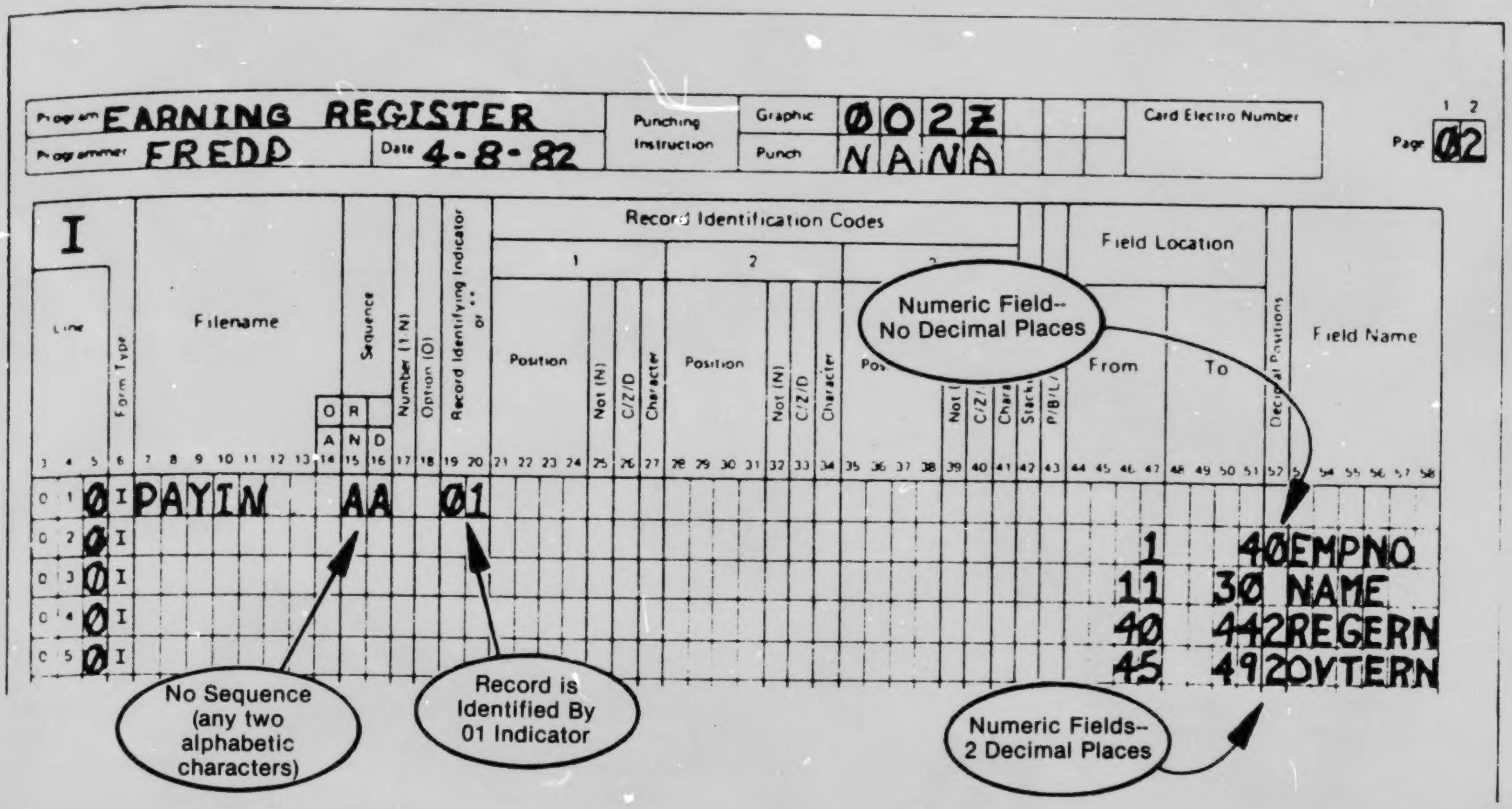
Fixed-length Records

Print Line Is 132 Characters

Overflow Indicator

Output Written On A Printer

Input Specifications Form



Program EARNING REGISTER

Programmer FREDD

Date 4-8-82

Punching Instruction

Graphic	0	O	2	Z
Punch	N	A	N	A

Card Electro Number

Page 02

I

Line	Form Type	Filename	Sequence	Record Identifying Indicator	Field Location From	Field Location To	Decimal Positions	Field Name
010	I	PAYIN	AA	01				
020	I				1	4	0	EMPNO
030	I				11	30		NAME
040	I				40	44	2	REGERN
050	I				45	49	2	OVTERN

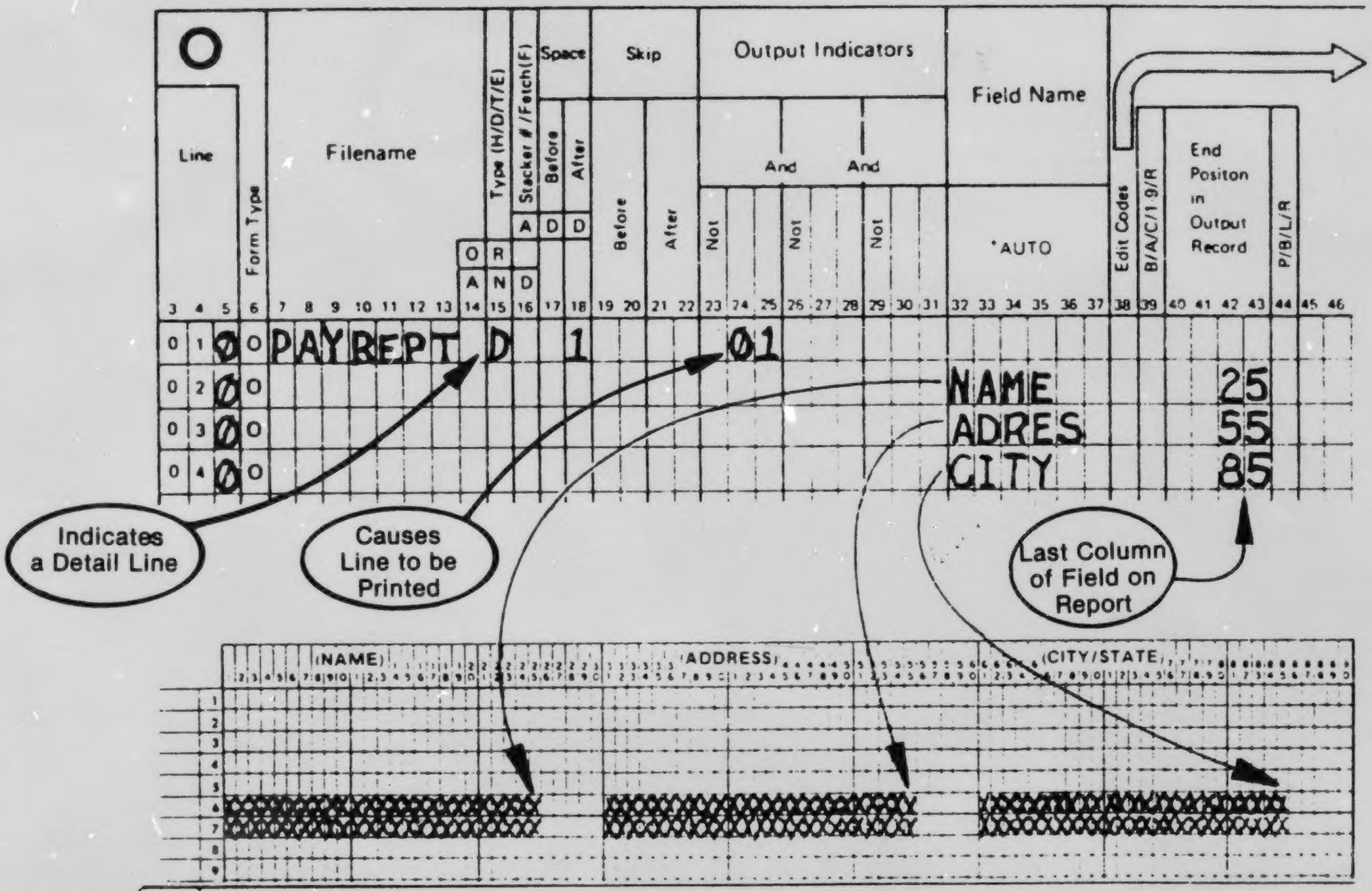
Numeric Field-- No Decimal Places

No Sequence (any two alphabetic characters)

Record is Identified By 01 Indicator

Numeric Fields-- 2 Decimal Places

Output Specifications Form


O
Line
Form Type
Filename
Type (H/D/T/E)
Stacker # / Fetch (F)
Space
Before
After
Skip
Before
After
Output Indicators
And
And
Not
Not
Not
Field Name
*AUTO
Edit Codes
B/A/C/1-9/R
End Positon in Output Record
P/B/L/R
OR
AND
A D D
(NAME)
(ADDRESS)
(CITY/STATE)

Line	Form Type	Filename	Type (H/D/T/E)	Space After	Output Indicators	Field Name	End Positon in Output Record
010	O	PAYREPT	D	1	01		
020	O					NAME	25
030	O					ADRES	55
040	O					CITY	85

Indicates a Detail Line

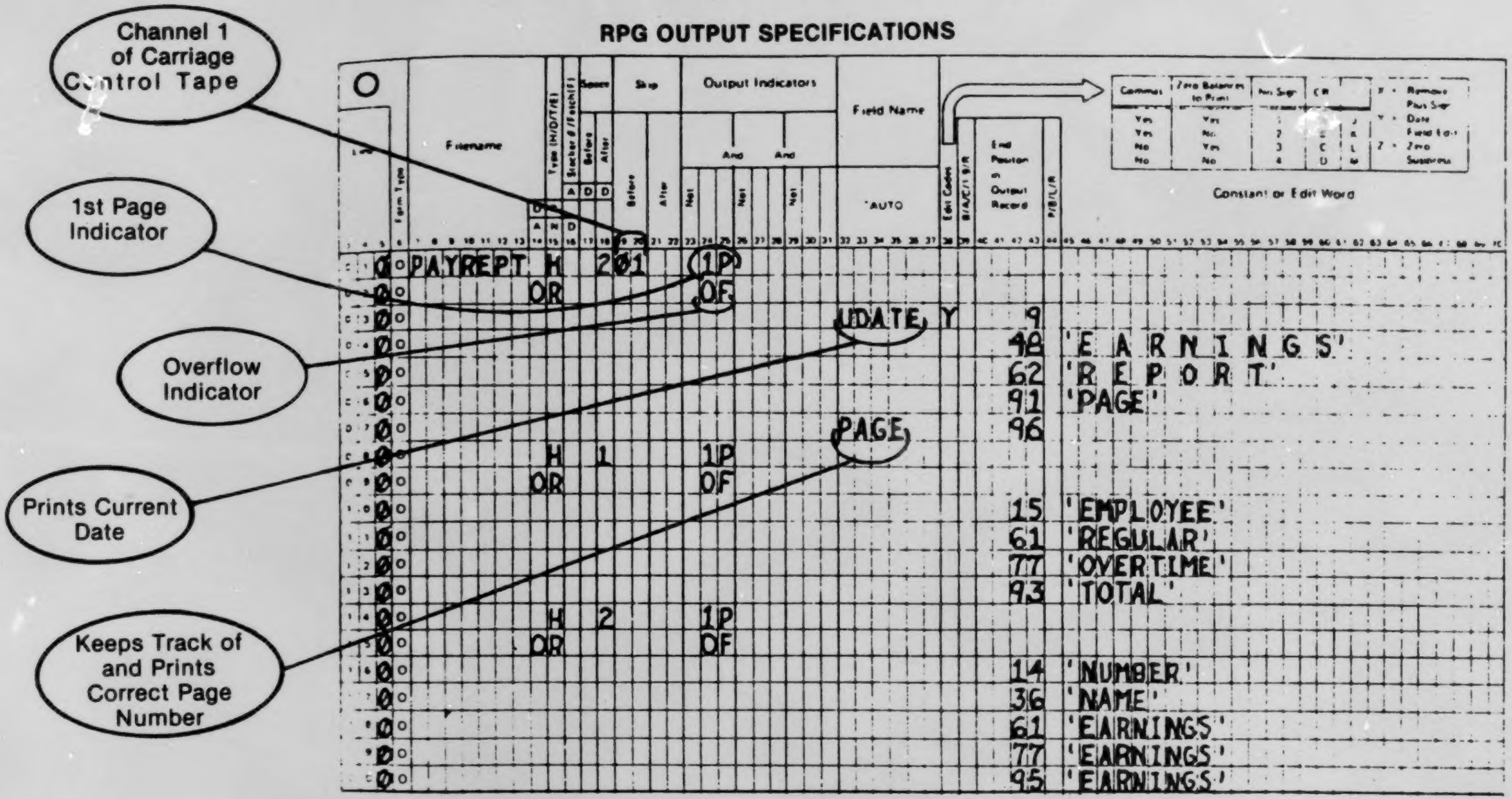
Causes Line to be Printed

Last Column of Field on Report

```
Fredd, Sharon L.     533 Lunar   Hannibal, MO   63401
Vittetoe, Jerry A.  610 Light   Kirksville, MO  63501
```

Printing Headings

RPG OUTPUT SPECIFICATIONS



Channel 1 of Carriage Control Tape

1st Page Indicator

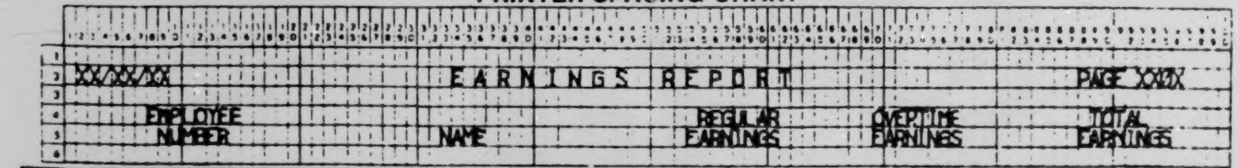
Overflow Indicator

Prints Current Date

Keeps Track of and Prints Correct Page Number

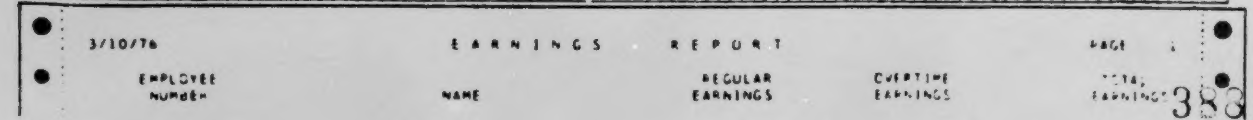
```
OPAYREPT H  201   1P
O      OR         OF
O                         UDATE Y    9
O                                  48 'E A R N I N G S'
O                                  62 'R E P O R T'
O                                  91 'PAGE'
O                         PAGE      96
O        H  1     1P
O      OR         OF
O                                  15 'EMPLOYEE'
O                                  61 'REGULAR'
O                                  77 'OVERTIME'
O                                  93 'TOTAL'
O        H  2     1P
O      OR         OF
O                                  14 'NUMBER'
O                                  36 'NAME'
O                                  61 'EARNINGS'
O                                  77 'EARNINGS'
O                                  95 'EARNINGS'
```

PRINTER SPACING CHART



```
XX/XX/XX                 E A R N I N G S   R E P O R T                         PAGE XXXX

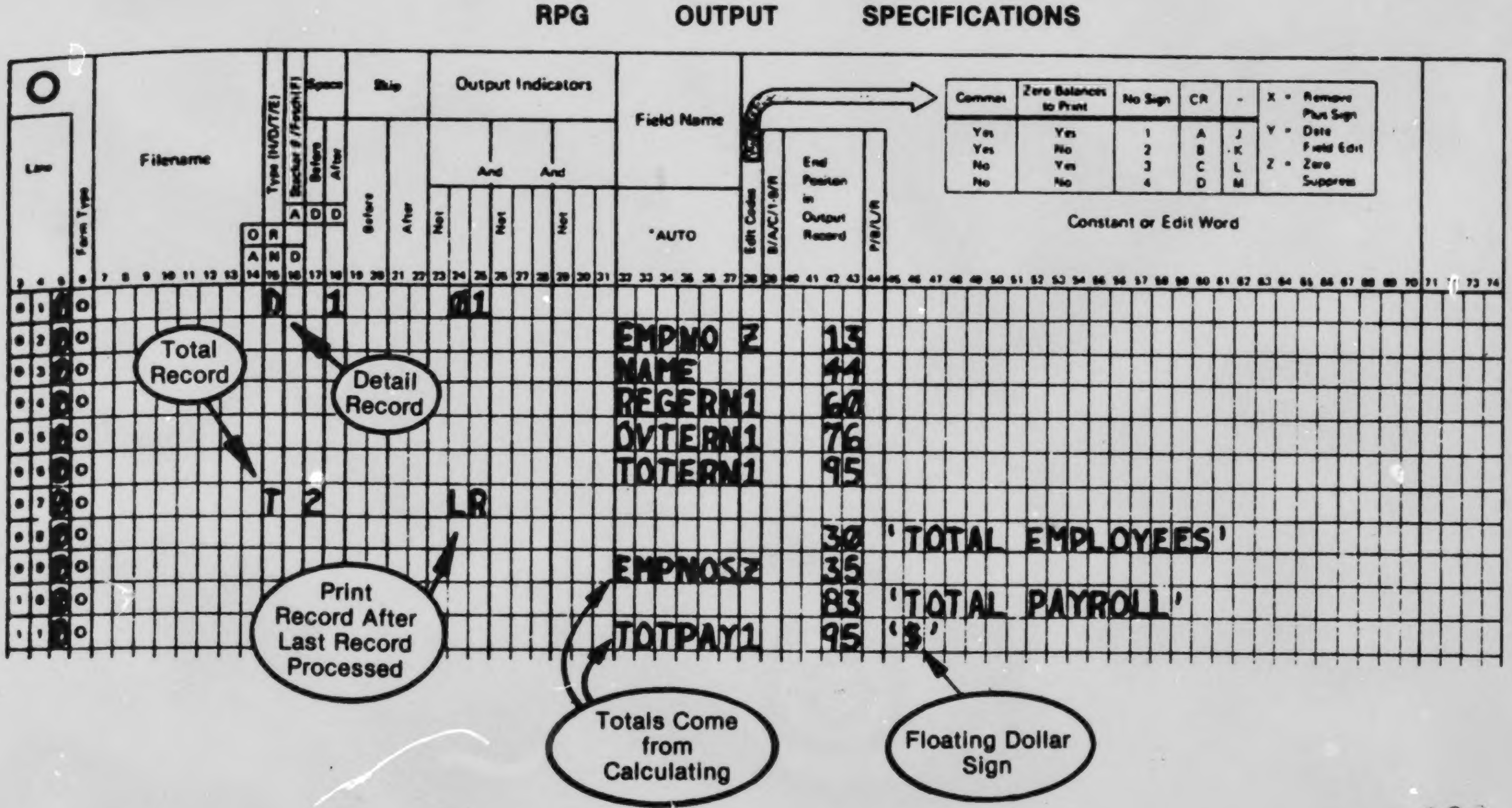
      EMPLOYEE                                       REGULAR        OVERTIME        TOTAL
       NUMBER               NAME                     EARNINGS       EARNINGS       EARNINGS
```



```
3/10/76                  E A R N I N G S     R E P O R T                         PAGE    1

      EMPLOYEE                                       REGULAR        OVERTIME        TOTAL
       NUMBER               NAME                     EARNINGS       EARNINGS       EARNINGS
```

Printing Total Lines



RPG OUTPUT SPECIFICATIONS

```
Line Form  Filename   Type Space Skip  Output      Field Name  End
     Type                  B  A        Indicators              Position
01   O                D       1        01
02   O                                             EMPNO Z     13
03   O                                             NAME        44
04   O                                             REGERN1     60
05   O                                             OVTERN1     76
06   O                                             TOTERN1     95
07   O                T       2        LR
08   O                                                         30 'TOTAL EMPLOYEES'
09   O                                             EMPNOSZ     35
10   O                                                         83 'TOTAL PAYROLL'
11   O                                             TOTPAY1     95 '$'
```

Commas	Zero Balances to Print	No Sign	CR	-
Yes	Yes	1	A	J
Yes	No	2	B	K
No	Yes	3	C	L
No	No	4	D	M

X = Remove Plus Sign
Y = Date Field Edit
Z = Zero Suppress

Line
Form Type
Filename
Type (H/D/T/E)
Stacker #/Fetch(F)
Space
Before
After
Skip
Before
After
Output Indicators
And
And
Not
Not
Not
Field Name
*AUTO
Edit Codes
B/A/C/1-9/R
End Position in Output Record
P/B/L/R
Constant or Edit Word

Total Record

Detail Record

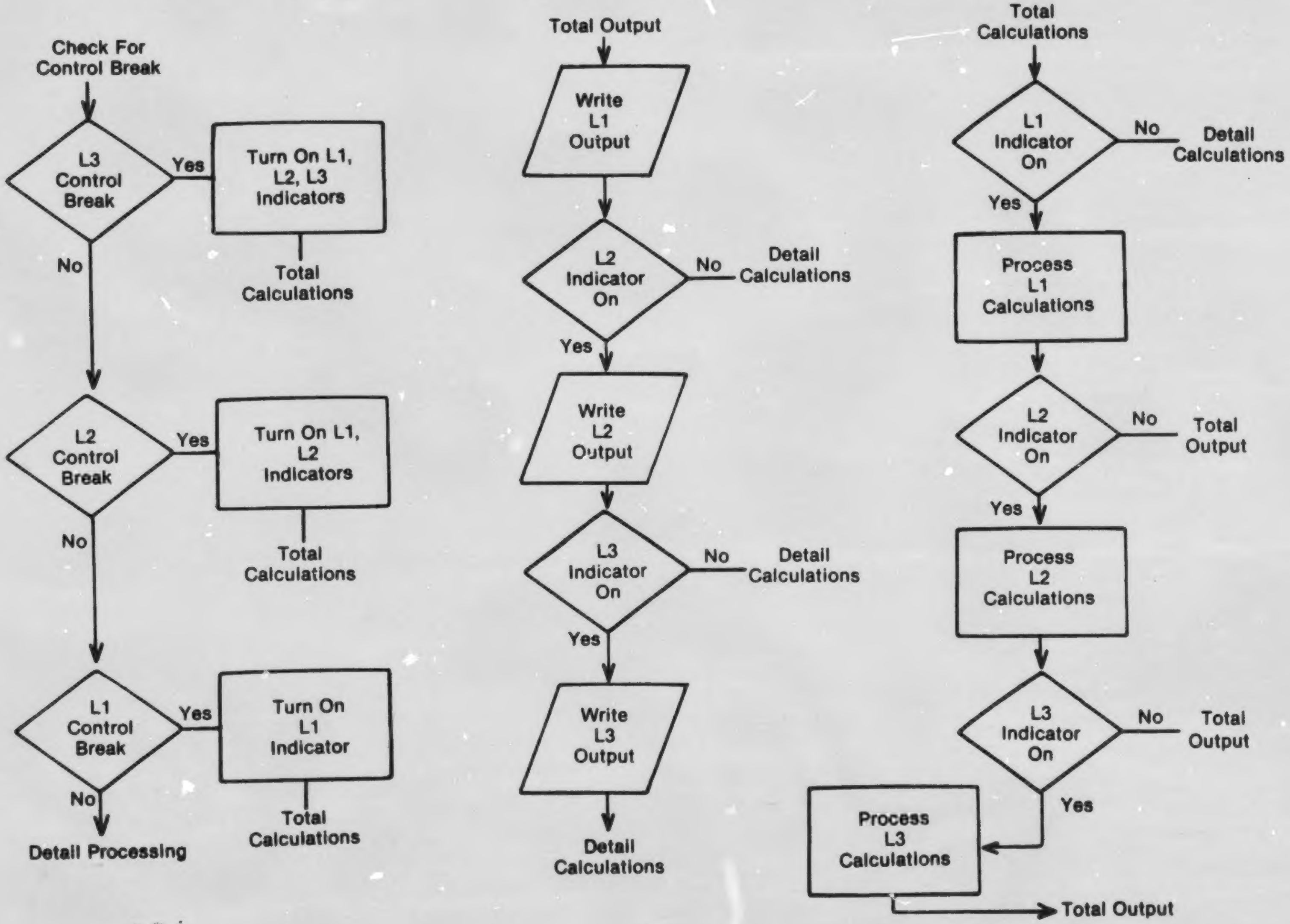
Print Record After Last Record Processed

Totals Come from Calculating

Floating Dollar Sign

RPG II Fixed Logic– Multiple Control Breaks

The following diagram graphically summarizes the processing that takes place when an L1, L2, or L3 control break occurs.


Check For Control Break
L3 Control Break
Yes
Turn On L1, L2, L3 Indicators
Total Calculations
No
L2 Control Break
Yes
Turn On L1, L2 Indicators
Total Calculations
No
L1 Control Break
Yes
Turn On L1 Indicator
Total Calculations
No
Detail Processing
Total Output
Write L1 Output
L2 Indicator On
No
Detail Calculations
Yes
Write L2 Output
L3 Indicator On
No
Detail Calculations
Yes
Write L3 Output
Detail Calculations
Total Calculations
L1 Indicator On
No
Detail Calculations
Yes
Process L1 Calculations
L2 Indicator On
No
Total Output
Yes
Process L2 Calculations
L3 Indicator On
No
Total Output
Yes
Process L3 Calculations
Total Output

L1, L2, L3 Control Breaks

INPUT SPECIFICATIONS

Line	Form Type	Filename	Sequence	Record Identifying Indicator	Field Location From	Field Location To	Decimal Positions	Field Name	Control Level (L1-L9)
010	I	SLSCARD	AA	01					
020	I				1	2	0	BRANCH	L3
030	I				3	4	0	SLSMAN	L2
040	I				5	9	0	CUSTNO	L1
050	I				10	14	2	SLSAMT	

OUTPUT SPECIFICATIONS

Line	Form Type	Control Level (L0-L9, LR, SR, AN/OR)	Indicators	Factor 1	Operation	Factor 2	Result Field Name	Length	Decimal Positions
010	C		01	SLSAMT	ADD	CUSTOT	CUSTOT	6	2
020	C	L1		CUSTOT	ADD	SMTOT	SMTOT	7	2
030	C	L2		SMTOT	ADD	BRTOT	BRTOT	7	2
040	C	L3		BRTOT	ADD	FINTOT	FINTOT	8	2

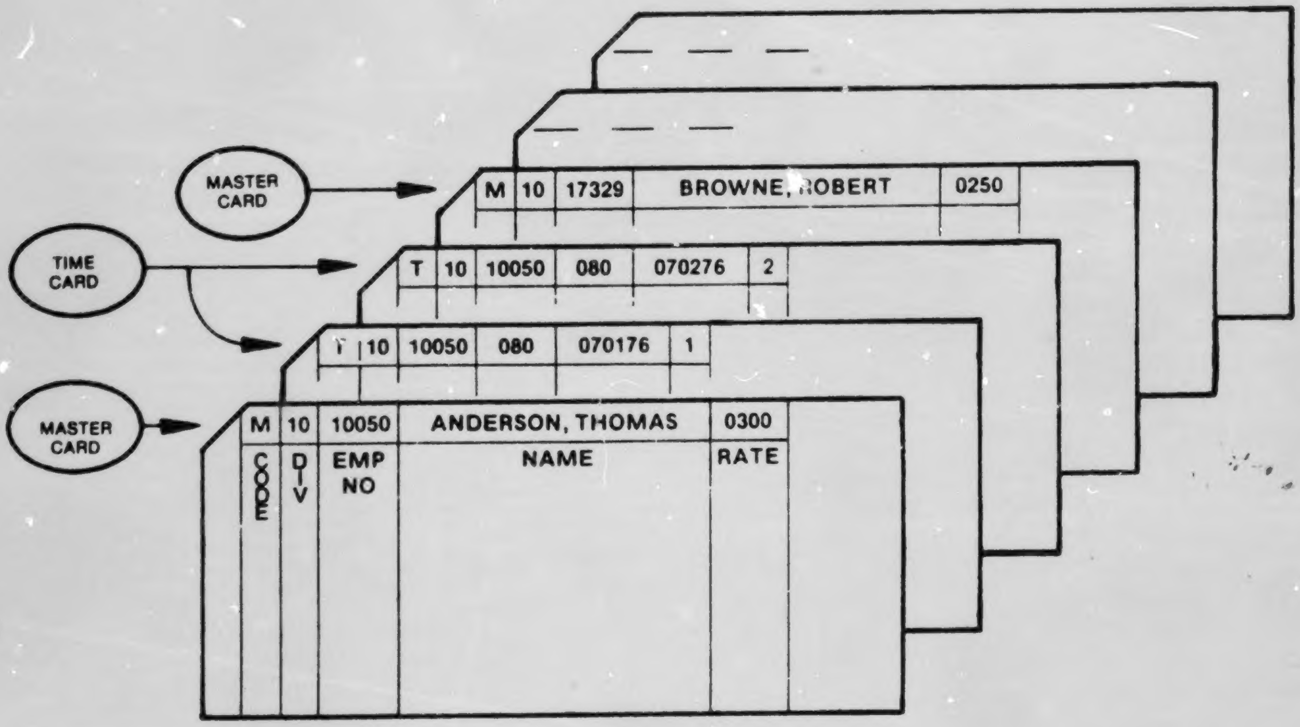
CALCULATION SPECIFICATIONS

Commas	Zero Balances to Print	No Sign	CR	-
Yes	Yes	1	A	J
Yes	No	2	B	K
No	Yes	3	C	L
No	No	4	D	M

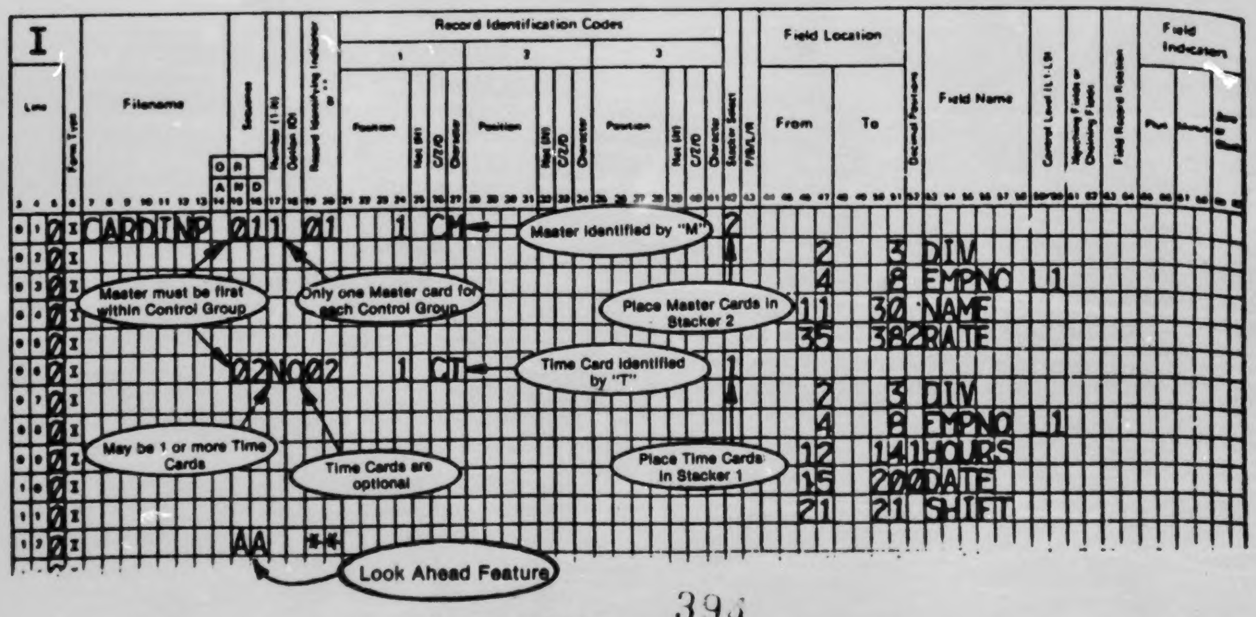
X = Remove Plus Sign
Y = Date Field Edit
Z = Zero Suppress

Line	Form Type	Filename	Type (H/D/T/E)	Space Before	Space After	Output Indicators	Field Name	Edit Codes	Blank After	End Position in Output Record	Constant or Edit Word
010	O	SLSREPT	D		1	01					
020	O						BRANCH	Z		4	
030	O						SLSMAN	Z		16	
040	O						CUSTNO	Z		30	
050	O						SLSAMT	1		45	
060	O		T		2	L1					
070	O						CUSTOT	1	B	45	
080	O									46	'*'
090	O		T	1	2	L2					
100	O									42	'TOTAL SALESMAN NO'
110	O						SLSMAN	Z		45	
120	O						SMTOT	1	B	54	
130	O									56	'**'
140	O		T		3	L3					
150	O									46	'TOTAL BRANCH NO'
160	O						BRANCH	Z		49	
170	O						BRTOT	1	B	61	
[illegible]	O									[illegible]	'***'

Sequenced Multiple Record Types


MASTER CARD
TIME CARD
MASTER CARD
M 10 17329 BROWNE, ROBERT 0250
T 10 10050 080 070276 2
T 10 10050 080 070176 1
M 10 10050 ANDERSON, THOMAS 0300
CODE
DIV
EMP NO
NAME
RATE

INPUT SPECIFICATIONS


I
Record Identification Codes
Field Location
From
To
Field Name
Filename
Position
Field Indicators
Master identified by "M"
Master must be first within Control Group
Only one Master card for each Control Group
Place Master Cards in Stacker 2
Time Card identified by "T"
May be 1 or more Time Cards
Time Cards are optional
Place Time Cards in Stacker 1
Look Ahead Feature

```
01ØICARDINP Ø11 Ø1   1 CM              2
02ØI                                        2   3 DIV
03ØI                                        4   8 EMPNO L1
04ØI                                       11  30 NAME
05ØI                                       35  382RATE
06ØI        Ø2NOØ2   1 CT              1
07ØI                                        2   3 DIV
08ØI                                        4   8 EMPNO L1
09ØI                                       12  141HOURS
10ØI                                       15  2ØØDATE
11ØI                                       21  21 SHIFT
12ØI        AA  **
```

RPG COMPUTER PROGRAMMING
UNIT VIII

ASSIGNMENT SHEET #1: INTRODUCTION TO RPG

Directions: Answer the Review Questions in the spaces provided and complete the Exercises as listed.

Review Questions

1. What are the rules for constructing a file name?

2. Explain the following entries in the file description specifications.

   a. I and O in column 15 -

   b. P in column 16 -

   c. F in column 19 -

3. Name three allowable entries for the DEVICE field on the file description form.

4. What entries are required in the sequence columns of the Input Specifications when the records are in no prescribed sequence?

5. Name the purpose of the Record Identifying Indicator.

6. What is a detail line?

Exercises

1. Record the entries on the File Description Specifications to define a disk file named CARDSIN and the entries to define a printer output file called CARDSOUT.

2. Record appropriate entries to define input fields from the file defined in (1) above. They are:

Columns 1 - 5	Employee number
Columns 20 - 39	Employee name
Columns 65 - 70	Department number

3. Record appropriate entries on the output specifications form for a printer file. Center the report with the fields in the following order:

Department Number	Employee Number	Employee Name

RPG COMPUTER PROGRAMMING
UNIT VIII

ASSIGNMENT SHEET #2: ARITHMETIC OPERATIONS

Directions: Answer the Review Questions and perform the Exercises.

Review Questions

True or False. Answer "T" or "F".

_____ 1. Calculations can be conditioned by indicators being set ON or OFF.

_____ 2. The operation field on the calculation specifications sheet need not always contain an operand.

_____ 3. Data coded in Factor 1 or Factor 2 can be either a data name field or constant data.

_____ 4. The result field holds the results of the operation specified in the operation field.

_____ 5. The operand for multiplication is MULT.

_____ 6. The results of an arithmetic operation could be positive, negative, or zero.

_____ 7. Calculations must be performed on each RPG cycle.

_____ 8. The operand for division is DIVIS.

_____ 9. In the division operation, Factor 2 is divided by Factor 1.

Exercises

Write the entries of the calculation specifications to accomplish the following:

1. Subtract PAYMT from BAL storing the result in NEWBAL. NEWBAL is 7 digits in length with 2 decimal positions. The calculation is to be performed when Indicator 02 is "on."

2. Multiply QTY by COST to get TOTAL. QTY is 3 digits in length and cost is 4 digits in length and specified in dollars and cents. The calculation is to be performed when Indicator 8 is "on."

3. Divide a 3-digit field SCORES by 3 to get AVG. SCORES contains no decimal point. The calculation should be performed when 05 is "on."

4. Add the value 10.00 to the value stored in ACCUM and have the sum stored in TOTAL. The maximum size answer which could be stored in TOTAL is 9,999.99. The calculation should be performed when 15 is "on."

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UNIT VIII

ASSIGNMENT SHEET #3: COMPARING

Directions: Answer the Review Questions and perform the Exercises.

Review Questions

1. Explain the operation of the Compare statement and indicate the method of coding COMP.

2. How does a numeric comparison take place?

3. How does an alphanumeric comparison take place?

4. If a Dept. No. field containing BQ is compared to another Dept. No. field containing BG, which field is considered larger?

5. Explain the difference between output indicators which are specified on the same line as the file name and output indicators which are specified on the same line as a field name. (Bonus Question)

Exercises

1. Specify the results of the following comparisons.

	Field A	Field B	Result (A>B, A<B, A=B)
a.	Roberts, Bill	Roberts, Billy	
b.	12.879	12.87	
c.	.0005000	00.0005	
d.	3.9987	03.998700	
e.	Art	Arthur	

2. Write the Compare statement on the calculations specifications to compare the field AMT to the field MAS. If AMT is less than MAX, turn on Indicator 30. If it is equal to MAX, turn on Indicator 31; and if AMT is greater than MAX, turn on Indicator 32. The Compare takes place when 01 is "on."

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ASSIGNMENT SHEET #4: CONTROL BREAKS

Directions: Answer the Review Questions in the spaces provided and complete the Exercises as listed.

Review Questions

1. When does a control break occur?

2. How does a control break affect the input specifications?

3. How does a control break affect the calculations specifications?

4. How does a control break affect the output specifications?

5. What is meant by RPG Fixed Logic?

Exercises

1. Record the appropriate entries on the input specifications to define an input record with these fields:

Columns 1 - 5	Employee Number
Columns 6 - 25	Name
Columns 50 - 52	Division

A control break is to occur when the employee number changes.

2. Record the entries on the calculations specifications to add the value "1" to an EMPNO counter when a record is read and the entry to add the total to the TOTDAY counter when the employee number changes.

3. Write the output specifications for a REPORT file, which is to contain a listing of the above, and the total days worked for each employee. At the end of the report, the number of days worked for all employees is to be printed. Design the format for the output.

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ASSIGNMENT SHEET #5: MULTIPLE CONTROL BREAKS

Directions: Answer the Review Questions in the spaces provided and complete the Exercises as listed.

Review Questions

1. Explain the use of control level indicators within a program. Use your own example to explain how Level Indicators would be used to solve a business problem.

True or False. Answer the following "T" or "F".

____ 2. The data field of least significance is assigned the highest control level number.

____ 3. After the first record of a control group is read, the level number assigned will be turned "on".

____ 4. Once a level number has been assigned to an input control group, it must be used each time that control group is used within the program.

____ 5. Control level indicators are not used on the calculation specifications.

____ 6. Each time a different customer's invoice is printed, the total should be reinitialized to zero by using the Blank After concept.

Exercises

1. The following fields should be defined for the input file:

Columns 1 - 5	Customer Number
Columns 6 - 8	Sales District
Columns 9 - 11	State
Columns 12 - 16	Sales Amount

The records are sorted in sequence with the State the major field, Sales District the intermediate field, and Customer Number the minor field. Totals are to be taken for the Customer Number, the Sales District, and the State whenever these values change. Write the entries on the input specifications to define the fields and cause the proper control breaks.

2. Write the entries on the calculation specifications to total the sales amount for each customer, for each district when the customer number changes, and for each state when the sales district changes. In addition, a final total is to be taken for all of the states.

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ASSIGNMENT SHEET #6: MULTIPLE RECORD TYPES

Directions: Complete the Exercises below.

Exercises

1. Code the input specifications to define two input records which will be read from the INPUT file.

   Balance Record: Col. 1 - "B"
   Col. 2 - 6: Department number - the L1 control level field
   Col. 10 - 15: Balance - will be used in arithmetic operations (2 decimal positions)

   Transaction Record: Col. 1 - "T"
   Col. 2 - 6: Department number - the L1 control level field
   Col. 25 - 30: Invoice amount - will be used in calculations (2 decimal positions)

   There will be one Balance Record for each department and it will be the first record within the control group. There may be one or more Transaction Records. There must be at least one Transaction Record. The Code field (Col. 1) must be used in a Look Ahead operation.

2. Write instructions to compare the Look Ahead field in Problem 1 to the value "T". If it is not equal, turn "on" indicator 35.

3. Write the instructions on the calculation specifications to bypass the operation in exercise #2 if indicator 20 is "on" and indicator 25 is "off".

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ASSIGNMENT SHEET #7: EXCEPTION OUTPUT

Directions: Answer the Review Questions in the spaces provided and complete the Exercises as listed.

Review Questions

1. Give an example of when you might need to use the EXCPT instruction.

2. What entry is required on the output specifications to indicate Exception output? Where must exception lines be defined?

Exercises

Record the entries on the input, calculation, and output specifications to punch four employee time cards for each employee from an employee master record. The employee master record is stored on punched cards and contains an employee number in card columns 1 - 9, the employee name in columns 10 - 25, and the department number in columns 40 - 41. The time card is to have the same format as the master record.

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UNIT VIII

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET #1

Review Questions

1. a. 1 - 8 characters in length
   b. Must begin with alphabetic character or the special characters $, @, or #
   c. Remainder of name may consist of alphabetic or numeric characters or the three special symbols

2. a. Indicates that the file is described as an input or output file
   b. Indicates the file is a primary file
   c. Indicates that the records are fixed in length

3. Refer to your system's manual for correct device names.

4. Any two alphabetic characters

5. It is used to specify a value that will be associated with the record which is read from the input file.

6. It is a type of line that is printed for each record which is read.

Exercises (should be done on coding sheets using proper columns)

1.
```
CARDSIN IP     F            96              Reader
CARDSOUT       F           132              Printer
```

2.
```
CARDSIN SF        01
                             1     5 NUM
                            20    39 NAME
                            65    70 DEPT
```

3.
```
CARDSOUT D  1     01
```

(rest of layout evaluated by instructor)

ASSIGNMENT SHEET #2

Review Questions

1. T
2. F
3. T
4. T
5. T
6. T
7. F
8. F
9. F

Exercises (should be done on coding sheets using proper columns)

1.	02	BAL	SUM	PAYMT	NEWBAL	72
2.	08	QTY	MULT	COST	TOTAL	52
3.	05	SCORES	DIV	3	AVG	30
4.	15	10	ADD	ACCUM	TOTAL	62

ASSIGNMENT SHEET #3

Review Questions

1. Causes contents in Factor 1 to be compared with contents in Factor 2. Outcome can be used to set on indicators that have been specified in RESULTING INDICATORS on the form.

   Example: FIELDA COMP FIELDB 010203

2. Begins with the extreme right position and moves to the left

3. Begins with the extreme left character and proceeds one character at a time to the right

4. BQ

5. Same line as file name - All fields within the file not having a specific indicator with it will print.

   Same line as field name - Indicates whether or not that specific field will print out or not

Exercises

1. a. A B
   b. A B
   c. A = B
   d. A = B
   e. A B

2. 01 AMT COMP MAS 3033132

ASSIGNMENT SHEET #4

Review Questions

1. When the value in a given input field changes from the value read on a previous input record

2. Control level, columns 59 and 60, is used to designate a control field. Valid entries are L1 - L9.

3. If totals are to be accumulated when a control break occurs, control level - columns 7 and 8 on the calculation specification - are used.

4. Control level indicators may also be used to cause group printing and proper totals to be printed.

5. RPG fixed logic is the prescribed sequence in which operations will occur in the object program generated by the RPG compiler.

<u>Exercises</u> (should be done on coding sheets using the proper columns)

1.
```
EMPIN   AA      01
                               1    5 NUM     L1
                               6   25 NAME
                              50   52 DIV
```

2.
```
   01          1         ADD       COUNT       COUNT       30
L1             COUNT     ADD       TOTAL       TOTAL       40
```

3.
```
REPORT  D    1    01
                               NUM       6
                               NAME     30
                               DIV      35
        T   12    L1
                               COUNT1B  45
        T    1    LR
                               TOTAL1   45
```

ASSIGNMENT SHEET #5

Review Questions

1. To be evaluated by instructor
2. F
3. T
4. T
5. F
6. T

Exercises (should be done on coding sheets using proper columns)

```
1.  SALES    AA     01
                            1      5 NUM    L1
                            6      8 DIST   L2
                            9     11 STATE  L3
                           12     162AMOUNT

2.     01      AMOUNT       ADD     CUSTOT           CUSTOT   62
   L1          CUSTOT       ADD     DISTOT           DISTOT   62
   L2          DISTOT       ADD     STATE            STATE    72
   L3          STATE        ADD     FINAL            FINAL    82
```

ASSIGNMENT SHEET #6

Exercises (should be done on coding sheets using proper columns)

```
1.  CARDIN  011    01    1 CB
                                         2     6 DEPT    L1
                                        10    152BAL
            02N    02    1 CT
                                         2     6 DEPT    L1
                                        25    302AMT
            AA   **
                                         1     1 CODE

2.  01      CODE       COMP       "T"                     3535

3.  20N25              GOTO       BYPASS
            CODE       COMP       "T"                     3535
            BYPASS     TAG
```

ASSIGNMENT SHEET #7

Review Questions

1. When you want to produce a variable number of output records in one cycle. Example: produce ten mailing labels for each record

2. E in column 15. It must be defined after all other lines.

Exercises (should be done on coding sheets using proper columns)

```
CARDIN    AA    05
                                      1     9 NUM
                                     10    25 NAME
                                     40    41 DEPT

           LOOP         TAG
                        EXCPT
           1            ADD         COUNT          COUNT   10
           COUNT        COMP        4                           25
   N25                  GOTO        LOOP
           COUNT        SUB         COUNT          COUNT

CARDS  E1        01
                          NUM    9
                          NAME  25
                          DEPT  41
```

RPG COMPUTER PROGRAMMING
UNIT VIII

JOB SHEET #1: INPUT/OUTPUT

I. Equipment

A. Computer

B. Floppy Disk

II. Procedure

Directions: In this assignment, you will read records and print a line for each record that is read. The data for this assignment are as listed below. Set up the format for the report. Code and run the program.

Col. 1 - 6	Part Number
Col. 7 - 9	Quantity
Col. 10 - 29	Part Description
Col. 30 - 32	Stockroom Number

TEST DATA:

271324	095	SYRINGE	023
452217	051	NEEDLES	027
254413	291	MASKS	300
772234	329	GLOVES	302
779924	023	GOWNS	303
997860	025	SCALPEL	725

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RPG COMPUTER PROGRAMMING
UNIT VIII

JOB SHEET #2: ARITHMETIC OPERATIONS AND EDIT CODES

I. Equipment

- A. Computer
- B. Floppy Disk

II. Procedure

Directions: In this assignment, you will code and run a Gross Profit Report. Input appears as follows:

Col. 1 - 5	Item Number
Col. 6 - 20	Description
Col. 21 - 25	Sales Amount (2 decimal positions)
Col. 26 - 30	Cost Amount (2 decimal positions)

Output consists of a listing of the above items in addition to Gross Profit. Gross Profit is found by subtracting the Cost Amount field from the Sales Amount field. Final totals are to be taken for Sales Amount, Cost Amount, and Gross Profit. You are to set up the proper format for the report which is to include headings. Use appropriate editing also.

TEST DATA:

10005	AMMONIA	06030	05000
10982	MATCHES	29500	20500
22650	NUTMEG	20900	17000
33569	BLEACH	57809	22156
44521	DETERGENT	05607	02178
55903	CLEANSER	42175	36598
69340	SPONGES	04487	03905

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UNIT VIII

JOB SHEET #3: COMPARING

I. Equipment

A. Computer

B. Floppy Disk

II. Procedure

Directions: In this assignment, you will code and run a Shipping Report. Input appears as follows:

Col. 1 - 5	Item Number
Col. 6 - 25	Description
Col. 26 - 29	Weight

Output should consist of the above three items. In addition, the words "AIR FREIGHT" or "TRUCK" should be printed on each line. If the shipping weight of an item is less than or equal to 500 pounds, the item is to be shipped by Air Freight. If the shipping weight is greater than 500 pounds, the item is to be shipped by truck. Totals are also to be accumulated for the number of items sent by Air Freight and the number sent by truck. Set up an appropriate format using headings and editing.

TEST DATA:

01225	STEEL BEAM	0298
22665	STEAM GENERATOR	2077
44810	ALUMINUM SIDING	0500
52697	STEEL SCRAP	1000
66113	COUPLING	0499
77221	WHEEL, STEEL	1001
81190	LIGHTPOST	0750

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UNIT VIII

JOB SHEET #4: CONTROL BREAKS

I. Equipment

- A. Computer
- B. Floppy Disk

II. Procedure

Directions: In this assignment, you will code and run a Sales Analysis Report. The report is to contain all the items on the input record. When there is a change in the Department number, a total for the department is to be printed. Space twice after printing the totals for the department. After all of the records have been processed, a final total is to be printed. Input appears as follows:

Col. 3 - 4	Department Number
Col. 5 - 7	Salesclerk Number
Col. 8 - 27	Name
Col. 35 - 41	Current Sales (2 decimal positions)

TEST DATA:

04	120	ALBERTS, J.	0052790
04	121	BANKOR, F.	0232850
04	123	JERSIT, P.	7924600
05	096	PETERS, P.	0045692
05	236	METYRS, T.	0987400
19	774	NIDER, T.	0093101

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UNIT VIII

JOB SHEET #5: MULTIPLE CONTROL BREAKS

I. Equipment

- A. Computer
- B. Floppy Disk

II. Procedure

Directions: In this assignment, you will code and run another Sales Analysis Report. Totals are to be taken by Item Number and Salesclerk Number. When there is a change in Item Number, an L1 total is to be taken; and when there is a change in Salesclerk Number, an L2 total is to be taken. After all records have been processed, a final total is to be taken. Design your output to include the following input fields in addition to the total lines mentioned.

Col. 1 - 3	Item Number
Col. 4 - 5	Salesclerk Number
Col. 6 - 20	Description
Col. 21 - 25	Sales Amount (2 decimal position)

TEST DATA:

241	11	SCREEN	24573
241	11	SCREEN	29891
241	11	SCREEN	49560
245	11	WINDOW	89499
245	11	WINDOW	75888
245	12	WINDOW	72599
245	12	WINDOW	72599
250	12	DOOR	85560
253	13	LATCH	00150

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UNIT VIII

JOB SHEET #6: MULTIPLE RECORD TYPES

I. Equipment

A. Computer

B. Floppy Disk

II. Procedure

Directions: In this assignment, you will code and run a payroll report. Input contains the following fields. The code field indicates whether the employee worked first, second, or third shift. If first shift is worked, there is no bonus; if second shift, there is a $5 bonus; and if third shift, there is a $10 bonus. If a valid code is not found in the input record, the message INVALID SHIFT should be printed. Output should consist of input items in addition to shift number, bonus, and total earnings. Total earnings are found by adding regular earnings, overtime earnings, and the bonus. The message END OF PAYROLL REPORT should be displayed after all records have been processed.

Col. 1 - 4	Employee Number
Col. 5 - 24	Employee Name
Col. 25 - 29	Regular Earnings (2 decimal positions)
Col. 30 - 34	Overtime Earnings (2 decimal positions)

TEST DATA:

0025	BAKER, ROGER	12500	05000	1
0098	DAVIS, FRED	15000	00000	2
0101	GRANGER, THOMAS	13535	00500	3
0522	LAFET, RAYMOND	25173	00100	6
1257	ZABO, ALEX	25030	25330	1

JOB SHEET #7: EXCEPTION OUTPUT

I. Equipment

- A. Computer
- B. Floppy Disk

II. Procedure

Directions: In this assignment, you will code and run a program that will print a set of mailing labels. The name is to be printed on the first line of the label, the address on the second line, and the city/state and zip on the third line. Each label is to be printed five times. After each mailing label is printed, the report is to be double-spaced.

Col. 1 - 25	Name
Col. 26 - 50	Address
Col. 51 - 75	City/State
Col. 76 - 80	Zip Code

TEST DATA:

HORACE BELCHER	721 BEMAN RD.	HOLLYWOOD, CA	92736
MYRON ISSON	37 KENNEDY AVE.	WASHINGTON, DC	02734
HOMER BRAVO	1776 FLAG DR.	PHILADELPHIA, PA	11771
PAUL NESS	69 STICKLE BLVD.	CHICAGO, IL	44442
NICK L. BAGLEY	10 NEEDLES AVE.	SAN FRANCISCO, CA	99691

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UNIT VIII

EXAMINATION

1. Matching: Match Column 1 to Column 2.

Column 1

____ a. Compiler
____ b. Output specification
____ c. Source program
____ d. Documentation
____ e. File description specifications
____ f. Object program
____ g. Input specifications

Column 2

1. Defines fields in input record
2. Problem definition
3. Facts concerning a problem
4. Converts to machine language
5. Defines I/O files
6. Source program is translated to
7. Defines report
8. RPG statements

2. Complete the following chart for each arithmetic operation:

Name of Operation	Key Word	Explanation
a. Addition	________	________________________
b. Subtraction	________	________________________
c. Multiplication	________	________________________
d. Division	________	________________________

3. Explain the operation of the Compare statement and distinguish between a numeric comparison and an alphabetic or alphanumeric comparison.

Numeric: ____

Alphanumeric: ____

4. Define a control break and give an example.

Example:

5. Explain what is meant by L1, L2, and L3 control breaks and give an example.

Example:

6. Explain the difference between RECORD IDENTIFYING INDICATORS and FIELD RECORD RELATION INDICATORS.

Record identifying indicators:

Field record relation indicators:

7. Give the purpose of the EXCPT operation and cite an example.

Example:

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UNIT VIII

ANSWERS TO EXAMINATION

1. a. 4
   b. 7
   c. 8
   d. 3
   e. 5
   f. 6
   g. 1

2. a. ADD - Factor 1 is added to Factor 2
   b. SUB - Factor 2 is subtracted from Factor 1
   c. MULT - Factor 1 is multiplied by Factor 2
   d. DIV - Factor 1 is divided by Factor 2

3. The Compare operation causes the contents of the field or literal in Factor 1 to be compared against the contents of the field or literal in Factor 2. The outcome of the operation can be used to set "on" indicators that have been specified in the Resulting Indicators portion of the form.

   Numeric comparison: The fields are compared beginning with the low order position of the whole number and moving to the left.

   Alphanumeric comparison: The comparison begins with the extreme left character and proceeds one character at a time to the right until all of the characters are found to be equal or until an unequal condition occurs.

4. A control break occurs when the value in a given input field changes from the value read on a previous input record.

   Example: When a department number changes from 01 to 02.

5. L1, L2, and L3 indicate that three control breaks will occur. An example might be a Sales Report which contains a branch number, a salesclerk's number, a customer's number, and a sales amount. When there is a change in the customer, an L1 control break occurs and the total sales for customer is printed. When there is a change in the salesclerk's number, an L2 control break occurs; and the customer and salesclerk's totals are printed. When there is a change in the branch number, an L3 control break occurs; and the totals for the customer number, salesclerk's number, and branch number are printed.

6. A Record Identifying Indicator is used to identify a given input record by relating the Record Identifying Indicator to the record defined.

   The Field Record Relation Indicator is used to specify which fields will be found in a record depending upon the value specified in the Record Identifying Indicator.

7. The EXCPT operation allows records to be written during total and detail calculation time. It is used when it is desired to produce a variable number of output records in one cycle.

   Example: You want to produce ten mailing labels for each record.

COBOL PROGRAMMING
UNIT IX

UNIT OBJECTIVE

After studying this unit, students should be able to write and execute correct COBOL programs.

SPECIFIC OBJECTIVES

After studying this unit, students should be able to:

1. Match terms and their definitions.
2. Supply headings for a COBOL coding form.
3. Define three factors in format notation.
4. List six rules for forming file- or data-names.
5. Select the correct sequence for the four COBOL divisions.
6. List the format of the Identification Division.
7. Differentiate between the Configuration Section and the Input-Output Section of the Environment Division.
8. Describe the purpose of the File Section of the Data Division.
9. List three different procedures which can be used in the Procedure Division.
10. Write three correct Procedure Division statements.
11. Explain the use of "9" and "V" in the PICTURE clause for numeric data.
12. Explain the purpose of the GIVING and TO options in ADD statements.
13. Explain a given SUBTRACT statement in some detail.
14. Compare the numeric output when using a "Z" and an "*" in a PICTURE clause.
15. Identify the term applied when data is moved from a larger field to a field that is too small.
16. Explain the difference between rounding and truncation.
17. Write a MULTIPLY statement with the GIVING option.

18. Write a DIVIDE statement with the GIVING option.

19. Write a COMPUTE statement.

20. Select the correct order in which arithmetic expressions are evaluated.

21. Name the correct statement an operator uses when asking for a message to be displayed on the printer or screen.

22. Explain the purpose of the WORKING-STORAGE Section.

23. Explain the use of "S" in a PICTURE clause.

24. Discuss the use of a VALUE clause.

25. Write, modify, and execute COBOL programs as assigned by your instructor.

COBOL PROGRAMMING
UNIT IX

SUGGESTED ACTIVITIES

I. Instructor

  A. Make transparencies.

  B. Provide students with objectives and discuss.

  C. Provide students with information and assignment sheets and discuss.

  D. Give examination.

II. Student

  A. Read objectives.

  B. Study information sheets as presented and assigned by instructor.

  C. Complete assignment sheets.

  D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit Content

  A. Objectives

  B. Notes to the instructor

  C. Information sheets

  D. Transparency masters

    1. TM-IX-1: The Hierarchy of COBOL Structure

    2. TM-IX-2: COBOL Coding Form

    3. TM-IX-3: COBOL Divisions 1 and 2

    4. TM-IX-4: Data Division Concept

    5. TM-IX-5: The Data Division

    6. TM-IX-6: The Procedure Division

E. Assignment sheets

   1. AS-IX-1: Field Identification and PIC Statements
   2. AS-IX-2: COBOL Coding and Statements
   3. AS-IX-3: COBOL Related to Flowcharts and Printed Output Design

F. Answers to assignment sheets

G. Examination

H. Answers to examination

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COBOL PROGRAMMING
UNIT IX

NOTES TO THE INSTRUCTOR

Many of the listed references contain projects and assignments for student use. Use these exercises to help students learn portions of COBOL before assigning long, involved problems to solve or programs to write.

Transparency #2
You may wish to duplicate or otherwise provide COBOL coding forms for students to use to practice coding programs and to further explain the use of coding forms.

Transparency #3, #5, and #6
Use these transparencies to introduce the division and section breakdown of COBOL. The information about your system and your students can then be plugged into these sections to make them more realistic.

COBOL PROGRAMMING
UNIT IX

INFORMATION SHEET

I. Terms and Definitions

A. ADD - a reserved word which causes addition of numeric values

B. AFTER ADVANCING - an optional reserved word used to control spacing in printed output

C. ASSIGN - a reserved word used to relate a file to a particular input-output device

D. CLOSE - a reserved word which terminates processing of units or files

E. COMPUTE - a reserved word which assigns to a data item the value of a numeric data item, literal, or arithmetic expression

F. DISPLAY - a reserved word used to print brief messages on the console typewriter, the printer, or card punch

G. DIVIDE - a reserved word which causes division of numeric values

H. Divisions - Identification, Environment, Data, and Procedure are divisions used in COBOL.

I. FD - an abbreviation for File Description which describes needed files

J. FILLER - a reserved word used when some characters in a record are not used in processing

K. GO TO - a reserved word which transfers program control

L. LABEL RECORDS - a reserved word which specifies presence of nonstandard labels on a file or the absence of labels

M. MOVE - a reserved word which moves data from one storage area to another or moves fields to be printed from input to output

N. MULTIPLY - a reserved word which causes multiplication of numeric values

O. OPEN - a reserved word which makes an area available for development of input-output files

P. PICTURE (PIC) - a reserved word which describes in detail an elementary level data item

Q. READ - a reserved word which makes available a logical record from input

R. RECORD CONTAINS - a reserved word which specifies maximum size of the logical records

S. Reserved words - words with preassigned meanings which are not used for other purposes. Source materials usually capitalize reserved words.

T. ROUNDED - an optional reserved word used to round up if low-order digit is five or more and drop if low-order digit is less than five

U. SELECT - a reserved word used to name each file in a program

V. SIGN - a reserved word which indicates presence of an operational sign, especially negative

W. STOP - a reserved word which ends program execution

X. SUBTRACT - a reserved word which causes subtraction of numeric values

Y. VALUE - a reserved word used to specify the initial value of working-storage items

Z. WRITE - a reserved word which causes a line to be printed from an output area

II. COBOL Coding Forms

A. Sequence - optional columns

1. Page, columns 1 - 3

2. Serial (line numbers), columns 4 - 6

B. Continuation/Comments, column 7

C. Area A, begins in columns 8 - 11

D. Area B, columns 12 - 72

E. Identification, columns 73 - 80

III. Format Notation

A. Generalized descriptions intended to guide the programmer in writing COBOL programs

B. Reserved words

  1. Written in all caps

  2. Words with preassigned meanings in the COBOL language and not used for any other purpose

  3. Words selected for use that are written in capital letters must be duplicated exactly.

C. Underlined reserved words

  1. Required reserved words (unless that portion of the code is optional)

  2. Must be included in coding exactly as shown or an error will result

D. Noise words

  1. Make code more readable in terms of English

  2. Capitalized but not underlined

E. Lower case words

  1. Represent information or names that must be supplied by the programmer

  2. Follow rules for programmer-supplied names

F. Brackets [ ]

  1. Indicate optional text

  2. Items enclosed in brackets may be used or omitted.

  3. Use depends on the requirements of the particular program.

G. Braces { }

  1. Indicate that one of the items enclosed must be chosen and coded

  2. Enclosed items may include programmer-supplied names, literals or figurative constants, reserved words, etc.

H. Punctuation is essential as it is shown.

I. Examples

PERFORM paragraph-name [UNTIL condition].

$$\underline{\text{MOVE}} \left\{\begin{array}{l}\text{literal}\\ \text{figurative constant}\\ \text{data-name-1}\end{array}\right\} \underline{\text{TO}}\ \text{data-name-2.}$$

- IV. Rules For Forming File- Or Data-Names
  - A. 1 - 30 characters in length
  - B. May use
    - 1. A - Z
    - 2. 0 - 9
    - 3. Hyphen for readability
  - C. Must not start or end with a hyphen
  - D. Must contain at least one letter (Paragraph-names may be all numeric characters.)
  - E. May not be reserved words
  - F. May not contain embedded blanks
    - 1. End of a file-name or data-name is detected by the space at the end.
    - 2. The entire word will not be recognized if there is a blank within it.
    - 3. Blanks will cause an error in compilation.
- V. Four COBOL Divisions
  - A. Identification Division
  - B. Environment Division
  - C. Data Division
  - D. Procedure Division
- VI. Identification Division
  - A. Identifies and documents the program
  - B. Division header entry
    - 1. Contains name of header
    - 2. Begins on a line by itself
    - 3. Begins in Area A

    4. Followed by a period
    5. Required entry

C. Paragraph headers

    1. Consist of a series of fixed names
        a. Program-ID (required entry)
        b. Author
        c. Installation
        d. Date-written
        e. Date-compiled
        f. Security
        g. Remarks
    2. Must begin in Area A
    3. Must be followed by a period and a space
    4. Words and sentences following paragraph headers must begin in Area B.

D. Program-name

    1. Follows Program-ID
    2. Consists of alphabetic and numeric characters
    3. First character must be alphabetic.
    4. First 8 characters of the program-name identify the object program.

E. Words following other paragraph headers

    1. May be originated at the discretion of the programmer
    2. May contain any character in the EBCDIC set
    3. If sentences are written, they must be contained in Area B.
    4. May not extend into columns 73 - 80
    5. Additional lines may be used as long as they are coded in Area B.

F. Each identification division entry must be followed by a period.

G. Format notation

```
IDENTIFICATION DIVISION.

PROGRAM-ID.  program-name
[Author.     [comment-entry] . . .]
[INSTALLATION.  [comment-entry] . . .]
[DATE-WRITTEN.  [comment-entry] . . .]
[DATE-COMPILED. [comment-entry] . . .]
[SECURITY.   [comment-entry] . . .]
[REMARKS.    [comment-entry] . . .]
```

VII. Environment Division

- A. Describes the computer and the hardware units
- B. Contains Configuration Section and Input-Output Section
- C. Configuration Section
  - 1. Identifies the computer on which the program is to be compiled and executed
  - 2. Section header
    - a. Configuration Section
    - b. Begins in Area A
    - c. Must be followed by a period and at least one space
  - 3. Paragraph header
    - a. Source-Computer names the computer on which COBOL compiler is to be run to prepare the object program.
    - b. Object-Computer identifies the computer on which the object program is to be run to process the data.
    - c. Must begin in Area A
    - d. Must be followed by a period and at least one space
    - e. Entries following paragraph headers must begin in Area B.
    - f. Entries following paragraph headers may begin on a separate line as long as they are contained in Area B.

4. Format notation

```
ENVIRONMENT DIVISION.

CONFIGURATION SECTION.
SOURCE-COMPUTER.  source-computer-entry.
OBJECT-COMPUTER.  object-computer-entry.
```

D. Input-Output Section

1. Contains information on file control and input/output devices

2. File-Control paragraph

    a. Names and associates the files to be processed with the input/output devices being used

    b. Format notation

```
FILE-CONTROL.

     SELECT Clause
     ASSIGN Clause
    [RESERVE Clause]
    [FILE-LIMIT Clause]
    [ACCESS MODE Clause]
    [PROCESSING MODE Clause]
    [ACTUAL KEY Clause]
```

    c. SELECT clause

        1) Used to name each file in a program
        2) Required entry in File-Control
        3) Must begin with the word SELECT
        4) Must be followed with a file-name
        5) Must begin in Area B

    d. ASSIGN clause

        1) Used to relate a file to a particular input/output device
        2) Required entry in File-Control
        3) Used to assign a file on an external device
        4) Begins with the word ASSIGN in Area B
        5) TO is a noise word and not required (optional word).
        6) System name - example: SYS008-UR-1403-S
            a) Grouping of information which specifies the type of device which is used for the file
            b) Symbolic device entry (SYS007)
                i) External name must begin with the letters 'SYS'.

            ii) Used by the operating system to associate a particular device with the file which is defined within the program
        c) Class entry (UR - unit record)
            i) Specifies the device class
            ii) UR (unit record) is used for card reader and printer.
        d) Device entry specifies the type of device which is to be used for the file (1403).
        e) Organization entry
            i) Indicates the file organization
            ii) S for sequential
            iii) All files with a UR class entry must have sequential organization.

e. Format notation for SELECT and ASSIGN

$\underline{\text{SELECT}}$ (file-name) $\underline{\text{ASSIGN}}$ TO $\begin{bmatrix}\text{UR}\\ \text{UT}\end{bmatrix}$ -(device)-
S-(external-name)

f. Example:

```
SELECT employee-name-file
    ASSIGN TO SYS007-UR-2540R-S
```

SYS007 is the symbolic device
UR is the class (unit record)
2540R is the device (card reader)
S is the organization (sequential)

VIII. Data Division

A. Describes the files to be processed by the object program

B. Contains definitions or further attributes of the file

    1. Length of the records in the file

    2. Formats of the records utilized in the file processing

C. Two sections

    1. File Section

    2. Working-Storage Section

D. File Section

    1. Describes the content and organization of the files to be processed

2. Describes the individual fields contained in a data record of a file

3. Format notation

   FD file-name

   [RECORD CONTAINS Clause]
   LABEL RECORDS Clause
   [DATA RECORDS Clause]

4. FD entry

   a. File Description (FD)

   b. Begins in Area A

   c. Describes each data file

   d. File-name must be the file-name used in the SELECT sentence.

   e. File-name begins in Area B.

   f. No period following the file-name (Period must occur only after all elements of the file have been defined.)

5. RECORD CONTAINS clause

   a. Specifies the maximum size of the logical records

   b. Format notation

      RECORD CONTAINS [integer-1 TO] integer-2
      CHARACTERS

   c. Not necessary for a file having equal length records

   d. Recommended for documentation purposes

   e. Record lengths are determined by the compiler whether or not the clause is specified.

   f. 80 characters are used for a card.

   g. 133 characters are used for the printer.

      1) 132 print positions available on the IBM 1403
      2) 1 extra position is used for carriage control.

6. LABEL RECORDS clause

   a. Specifies the presence of nonstandard labels on a file or the absence of labels

   b. Labels are used when processing data are stored on magnetic tape and magnetic disk.

   c. Format notation

$$\underline{\text{LABEL}}\ \left\{\begin{matrix}\underline{\text{RECORD}}\ \text{IS}\\ \underline{\text{RECORDS}}\ \text{ARE}\end{matrix}\right\}\ \left\{\begin{matrix}\underline{\text{OMITTED}}\\ \underline{\text{STANDARD}}\\ \text{data-name-1 [data-}\\ \text{name-2] . . .}\end{matrix}\right\}$$

   d. OMITTED option MUST be specified for file assigned to a unit record device.

7. RECORD description

   a. Describes the individual records within the file

   b. Specifies the characteristics of each item in a data record

   c. Every item must be described in a separate entry in the same order in which the item occurs in the record.

   d. Each entry consists of the following:

      1) Level number which must be 01
      2) Data-name
      3) Series of independent clauses followed by a period

   e. Format notation

$$\text{Level-number}\quad \left\{\begin{matrix}\text{data-name}\\ \underline{\text{FILLER}}\end{matrix}\right\}$$

[REDEFINES Clause]
[BLANK WHEN ZERO Clause]
[JUSTIFIED Clause]
[OCCURS Clause]
[PICTURE Clause]
[SYNCHRONIZED Clause]
[USAGE Clause].
[VALUE Clause].

8. Level indicators

   a. Show how data items are related to each other

b. FD - most inclusive grouping (file)

c. 01 - specifies a logical record (individual card), such as name-card

d. FD and 01 indicators must be in Area A.

e. Subordinate data items or fields constitute a logical record.

   1) Grouped in a hierarchy
   2) Identified by level numbers 02-49
   3) Fields within records are identified by additional level numbers.

9. Describing fields within a record

   a. Data-name or FILLER must be specified following the level number in Area B.

   b. May contain up to 30 characters

   c. Rules for naming the fields follow those for file names.

   d. Suffix may be used to indicate that the names refer to entries contained in an input or output record.

   e. Should be chosen because they represent the content of each name within the record

   f. Choose a data-name that

      1) Indicates the contents of the field
      2) Uses a prefix or suffix to indicate the source of the field

   g. FILLER

      1) Used when some of the characters in a record are not used in the processing steps of the program
      2) FILLER takes the place of a data-name.

10. PICTURE clause

   a. Associated with elementary items

b. Elementary items

  1) Those not further subdivided
  2) Must contain a PIC clause

c. Specifies a detailed description of an elementary level data item

d. Indicates whether the field contains letters of the alphabet only; letters of the alphabet, special symbols, and numbers; or numbers only

e. Format notation

$\left\{\begin{array}{l}\underline{\text{PICTURE}}\\ \underline{\text{PIC}}\end{array}\right\}$ IS character string.

  1) Character string consists of certain allowable combinations in the COBOL character set.
  2) These combinations determine the category of the elementary item.
  3) Three categories of data can be described with a PIC clause.
    a) Alphanumeric - may contain any of the characters available in the character set and represented by X
    b) Numeric - may contain only numbers 0-9 and represented by 9
    c) Alphabetic - may contain only letters of the alphabet and represented by A
  4) Always followed by a period
  5) Should begin in the same column for ease of reading

f. Describing the records

  1) PIC clauses represent the length of the field on the input record and the printed report.
    a) Length of field may be represented by a number enclosed in parentheses following the field indicator.
    b) Length of field may be represented by repeating the field indicator.
    c) Example: PIC XXXX. is the same as PIC X(4).
  2) Style of PIC clauses
    a) PIC X(2).
    b) PIC XX.

c) PICTURE X(18).
d) PIC 9.
e) PIC 9(18).
f) PIC AAA.

3) Entries are similar for the printed report, beginning with the FD entry from the file-name of the SELECT clause.

4) Example:
```
01 PRINT-LINE.
   03 FILLER        PIC X.
   03 NAME-PR       PIC X(20).
   03 FILLER        PIC X(5).
   03 ADDRESS-PR    PIC X(25).
   03 FILLER        PIC X(82).
```

5) 01 level indicator on the printed line identifies the symbolic name of the individual line to be printed.

6) 03 level indicators (could use 02-49) describe the format of the report.

a) First 03 level indicator is FILLER PIC X.
i) Used for carriage control
ii) Controls functions of single, double, or triple spacing

b) Second 03 level indicator is for NAME-PR (name-print).

c) Third 03 level indicator is FILLER PIC X(5) to allow five blank spaces between fields.

d) Last 03 level indicator is another FILLER, which is used to complete the line to 133 print positions.

E. Working-Storage Section (See XXII in the information sheets.)

IX. Procedure Division

A. Specifies those procedures needed to solve a given problem

B. Steps consist of the following:

1. Computations

2. Logical decisions

3. Input/output

C. Expressed in meaningful statements which employ the concept of verbs to denote actions, statements, and sentences to describe procedures

D. Must begin in Area A with the header PROCEDURE DIVISION

        1. Header must be recorded on a line by itself.
        2. Header must be followed by a period.

    E. Basic structure
        1. Consists of paragraphs containing a series of sentences
        2. Paragraphs
            a. Logical entries consisting of one or more sentences
            b. Must begin in Area A
            c. Must be followed by a period
            d. Ends at the next paragraph name or at the end of the Procedure Division
            e. Names should be meaningful, indicating the processing that is to take place within the paragraph.
            f. May contain a prefix number
                1) Ascending sequence for each subsequent paragraph name in the program
                2) Easier in large programs to determine where in the Procedure Division a paragraph is located
            g. Paragraph name is also called procedure name.
            h. Rules for forming paragraph names
                1) No more than 30 characters
                2) May contain letters A-Z, numbers 0-9, and/or hyphens
                3) No embedded blanks
                4) May not begin or end with a hyphen
                5) Must begin with a letter or number
                6) Period or space at the end serves as a signal for the end of the name.
        3. Sentences
            a. Single statement or series of statements
                1) Terminated by a period
                2) Followed by a space
            b. Single comma or semicolon (;) or the word THEN may be used as a separator between statements.

        1) Has no effect on the program
        2) Merely aids in readability

    c. Period is required punctuation symbol which indicates the end of a sentence.

F. COBOL verbs are the basis of the Procedure Division of a source program.

G. Basic classification of verbs

1. Input/Output
    - a. OPEN
    - b. READ
    - c. WRITE
    - d. CLOSE
    - e. ACCEPT
    - f. DISPLAY

2. Data manipulation
    - a. MOVE
    - b. EXAMINE

3. Arithmetic
    - a. ADD
    - b. SUBTRACT
    - c. MULTIPLY
    - d. DIVIDE
    - e. COMPUTE

4. Sequence control
    - a. GO TO
    - b. ALTER
    - c. PERFORM
    - d. STOP
    - e. EXIT

        5. Compiler-directing
            a. COPY
            b. ENTER
            c. NOTE
        6. Table-handling
            a. SEARCH
            b. SET

X. Common Procedure Division Statements

- A. OPEN statement
    1. Initiates the processing of files
    2. Must be executed prior to any other input/output statement for any file
    3. Does not make an input record available for processing
    4. Makes available an area for development of the first output record
    5. Format

```
OPEN  [INPUT    file-name     . . .]
      [OUTPUT   file-name     . . .]
      [I-O      file-name     . . .].
```

    6. INPUT must precede file name of the input file to be opened and is specified only once if more than one input file is used.
    7. OUTPUT must precede the output file to be opened and is specified only once if more than one output file is used.
    8. OPEN verb needs to be specified only one time in order to open both input and output files.
    9. Must be terminated by a period
- B. READ statements
    1. Functions
        a. Make available a logical record from an input file.

        b. Allow performance of specified operations when an end-of-file indicator is detected.

    2. End-of-File indicator is detected by the presence of end-of-data card, which contains a /* in columns 1 and 2. (Other input media may use other indicators.)

    3. When a READ statement is executed

        a. Next logical record in the named file becomes accessible in the input area defined by the associated record description entry.

        b. File-name must be defined by an FD entry in the Data Division.

        c. The record remains available in the input area until the next read statement (or a CLOSE statement) is executed.

        d. AT END option is required for files for which access is sequential.

        e. AT END portion of the READ statement is executed when an end-of-file condition is detected.

        f. Once the AT END portion of a READ statement is executed for a file, any subsequent attempt to read from that file or to refer to logical records in that file constitutes an error (unless subsequent CLOSE and OPEN statements have been executed).

        g. Format notation

$$\underline{\text{READ}}\ \ \text{file-name}\ \ [\text{RECORD}]\ \ [\underline{\text{INTO}}\ \text{identifier}]$$

$$\left\{\begin{array}{l}\text{AT }\underline{\text{END}}\\ \underline{\text{INVALID}}\text{ KEY}\end{array}\right\}\ \text{imperative statement.}$$

C. MOVE statements

    1. Clear printer output and storage areas.

    2. Move fields to be printed from the input area to the output area.

    3. Move data from one area of main storage to another.

    4. Figurative constants

a. COBOL standard data-name to which a value has been assigned

b. SPACE, SPACES represent one or more "blanks" or "spaces" when specified in a COBOL program.

c. ZERO, ZEROES, ZEROS represent one or more "0" when specified in a COBOL program.

d. MOVE statements using 'MOVE SPACES TO output-line' clear the print area by moving SPACES throughout the area.

e. This move is necessary to make sure that there is no extraneous information (garbage) in the output area from previous operations.

5. Format notation

$$\underline{\text{MOVE}} \quad \left\{ \begin{array}{l} \text{identifier-1} \\ \text{literal} \end{array} \right\} \quad \underline{\text{TO}} \quad \begin{array}{l} \text{identifier-2} \\ [\text{identifier-3}] \ldots \end{array}$$

a. "Identifier" when used in a MOVE statement refers to the data-name which is used to give a field a symbolic name.

b. When the MOVE statement is executed, the information stored in the field specified as "identifier-1" is moved to the area designated by "identifier-2."

c. The contents of "identifier-1" remain unchanged.

d. Literals are actual numbers, words, or special characters which may be used in certain COBOL statements.

6. When both the field from which the data to be moved and the receiving field are alphanumeric (defined by PIC X) or both fields are group items, the data placed in the receiving fields are aligned at the left.

7. The data in the receiving field are replaced by the data in the sending field.

8. The data in the sending field remain unchanged.

9. When the receiving field is smaller than the sending field, a truncation takes place on the right end of the data when placed in the receiving field.

10. When receiving field is larger than the sending field and when moving alphanumeric fields, the right portion of the receiving field will be filled with blanks.

11. If the sending and receiving fields are not the same length, a warning diagnostic will be printed during compilation.

D. WRITE statements

1. WRITE statement is used to cause a line to be printed after the fields have been moved to the output area.

2. Format notation

$$\underline{\text{WRITE}}\quad \text{record-name}\quad [\underline{\text{FROM}}\ \text{identifier-1}]$$

$$\left[\begin{Bmatrix}\underline{\text{BEFORE}}\\ \underline{\text{AFTER}}\end{Bmatrix}\quad \text{ADVANCING}\quad \begin{Bmatrix}\text{identifier-2 LINES}\\ \text{integer LINES}\\ \text{mnemonic-name}\end{Bmatrix}\right].$$

3. AFTER ADVANCING option is used for output designed to be printed, punched, or displayed.

    a. When this option is used, the first character in each logical record must be reserved for the carriage control character.

    b. Accomplished in the Data Division by a 'FILLER PIC X.' as the first entry describing the output-line

    c. If the AFTER ADVANCING option is used, every WRITE statement must contain an advancing option.

    d. "Integer" must be a nonnegative number and have a value of less than 100.

        1) 1 is used for single spacing.
        2) 2 is used for double spacing (one blank line between printed lines).

4. An OPEN statement must be executed prior to the execution of the first WRITE statement.

E. GO TO statements

1. Transfers control from one portion of the program to another

2. Format notation

$$\underline{\text{GO}}\ \underline{\text{TO}}\ \text{procedure-name-1.}$$

3. Provides a means of transferring the path of a program to a designated paragraph or section

4. Example:

```
020-READ.
    READ SALES-FILE AT END GO TO 030-END.
    MOVE NAME-IN TO NAME-OUT.
    WRITE PRINT-LINE AFTER ADVANCING 2 LINES
    GO TO 020-READ.
030-END.
    CLOSE SALES-FILE, PRINT-FILE.
    STOP RUN.
```

F. CLOSE statements

1. When the end-of-file indicator is detected indicating that all data have been read and processed, the program branches to end-of-job routine.

2. Files are closed and the program is completed.

3. Used to terminate the processing of one or more units or files

4. Format notation

```
CLOSE   file-name-1

        [file-name-2] . . .
```

5. CLOSE statement may only be executed after the files are opened.

6. After a CLOSE statement has been executed for a file, an OPEN statement must be executed before any other reference can be made to that file.

G. STOP statement

1. Last statement processed in the program

2. Format notation

$$\underline{\text{STOP}} \quad \left\{ \begin{matrix} \underline{\text{RUN}} \\ \text{literal} \end{matrix} \right\} .$$

3. Terminates execution of the object program and returns control to the "operating system."

XI. Definition of Numeric Data

A. PICTURE 9

1. Used to define data as numeric

2. Indicates that the data to be stored in the field will be numeric

3. Implied decimal point

   a. "V" within a PIC clause is used to tell the compiler where in the numeric field the decimal point is located.

   b. Examples:

      1) PICTURE 9V99 - 3-digit field
      2) PICTURE 9(5)V99 - 7-digit field
      3) PICTURE 9(9) - 9-digit field

   c. The "9" indicates that the fields are to be treated as numeric fields and they may be involved in arithmetic operations or editing.

   d. The "V" specifies the position of the assumed or implied decimal point.

   e. Storage is not reserved for the "V," and it is merely used to provide the compiler with the information concerning the decimal alignment of numeric items involved in computations.

XII. ADD Statements

A. Format notation with GIVING option

$$\underline{\text{ADD}} \quad \begin{Bmatrix}\text{identifier-1}\\ \text{literal-1}\end{Bmatrix} \begin{Bmatrix}\text{identifier-2}\\ \text{literal-2}\end{Bmatrix} \begin{bmatrix}\text{identifier-3}\\ \text{literal-3}\end{bmatrix} \ldots$$

$$\underline{\text{GIVING}} \quad \text{identifier-m} \quad [\underline{\text{ROUNDED}}] \quad [\text{ON } \underline{\text{SIZE}} \ \underline{\text{ERROR}} \ \text{imperative-statement}].$$

1. When using the GIVING option, the value of identifier-m that follows the word GIVING is made equal to the calculated result. Identifier-m might be an edited output field.

2. Ellipsis (. . .) indicates that the immediately preceding units may occur once, or any number of times in succession.

   a. A unit is one of the following:

      1) Single lower-case word
      2) Group of lower-case words
      3) One or more reserved words enclosed in brackets or braces

    b. In the ADD statement, an identifier or a numeric literal may be used a number of times.

3. A numeric literal is merely a number that may be used with arithmetic statements rather than identifiers, which reference fields containing numeric values.

4. When using the GIVING option, the answer is first developed in a work area set up by the compiler and then moved to the area referenced by identifier-m following the word GIVING.

5. Areas referenced as addends (identifier-1, identifier-2, etc.) remain unaltered after execution of the ADD statement.

6. Maximum number of operands that may be specified is 23.

7. Maximum size of any amount used in an arithmetic operation is 18 decimal digits.

B. Example of ADD statement with GIVING option

ADD reg-earnings-cd, ovt-earnings-cd GIVING tot-earnings-pr.

1. Field referenced by reg-earnings-cd is added to the field referenced by ovt-earnings-cd.

2. The answer is stored in the area referenced by tot-earnings-pr.

3. Comma used between successive operands is optional and serves only for clarity and ease of reading.

C. ADD statement with numeric literals

1. Example

   ADD reg-earnings, 5.00 GIVING tot-pay.

2. Numeric literal, i.e., 5.00 in example 1

   a. A constant or a number may be used in arithmetic statements rather than an identifier.

   b. Numeric literal must contain at least one digit and not more than 18 digits.

   c. May consist of the characters 0 through 9, the plus or minus sign, and the decimal point

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   d. If a numeric literal is unsigned, it is assumed positive.

   e. A decimal point may appear anywhere within the literal except as the extreme right character.

   f. If a numeric literal does not contain a decimal point, it is assumed to be a whole number.

3. The contents of the field referenced by reg-earnings and the numeric literal 5.00 are added, and the answer is stored in the area referenced by tot-pay.

D. ADD statement, TO option

1. Format notation

$$\underline{\text{ADD}} \quad \left\{\begin{matrix}\text{identifier-1}\\ \text{literal-1}\end{matrix}\right\} \quad \left[\begin{matrix}\text{identifier-2}\\ \text{literal-2}\end{matrix}\right] \; \ldots \; \underline{\text{TO}}$$

$$\text{identifier-m} \quad [\underline{\text{ROUNDED}}] \quad [\text{identifier-n } [\text{ROUNDED}]]$$

$$\ldots \; [\text{ON } \underline{\text{SIZE}} \; \underline{\text{ERROR}} \quad \text{imperative-statement}].$$

2. The value of all identifiers and literals (including identifier-m) are added, and the resulting sum replaces the value of identifier-m.

3. Example

   ADD sales TO counter

   a. The value in sales is added to the value in counter. The result is stored in counter, replacing the previous value in counter.

   b. The value in sales remains unchanged.

   c. The value in counter changes during execution so that it accumulates the values in sales.

4. Example: ADD 1 to counter

   a. Literals can also be used with the TO option.

   b. Counters and accumulators for final totals are often coded with the ADD statement and the TO option in COBOL.

   c. Counters and accumulators must be initialized or set equal to zero before processing.

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E. ADD verb

1. Fields are aligned according to the decimal point within each field.

2. All quantities are added algebraically.

3. If the size of the area which is to contain the sum after calculations are performed is not large enough to contain all of the positions, significant digits of the sum will be lost and an incorrect answer will develop.

XIII. SUBTRACT Statements

A. SUBTRACT statement subtracts one or more numeric data items from a specified item and sets the value of a data item equal to the difference.

B. Format notation 1

$$\underline{\text{SUBTRACT}} \quad \left\{ \begin{matrix} \text{identifier-1} \\ \text{literal-1} \end{matrix} \right\} \quad \left[\begin{matrix} \text{identifier-2} \\ \text{literal-1} \end{matrix} \right] \quad \ldots \quad \underline{\text{FROM}}$$

$$\text{identifier-m } [\underline{\text{ROUNDED}}] \quad [\text{identifier-n } [\underline{\text{ROUNDED}}]]$$

$$[\underline{\text{ON}}\ \underline{\text{SIZE}}\ \underline{\text{ERROR}} \text{ imperative-statement}].$$

1. Example: SUBTRACT FICA, Income-tax FROM gross-pay.

2. Amounts specified before the FROM are added and then subtracted from gross-pay.

3. The answer is stored in the area referenced by gross-pay.

4. Gross-pay is identifier-m, which contains the answer when the GIVING option is not used.

5. FICA and Income-tax are identifier-1 and identifier-2, respectively.

C. Format notation 2

$$\underline{\text{SUBTRACT}} \quad \left\{ \begin{matrix} \text{identifier-1} \\ \text{literal-1} \end{matrix} \right\} \quad \left[\begin{matrix} \text{identifier-2} \\ \text{literal-2} \end{matrix} \right] \quad \ldots$$

$$\underline{\text{FROM}} \quad \left\{ \begin{matrix} \text{identifier-m} \\ \text{literal-m} \end{matrix} \right\} \quad \underline{\text{GIVING}} \quad \text{identifer-n}$$

$$[\underline{\text{ROUNDED}}] \quad [\text{ON } \underline{\text{SIZE}}\ \underline{\text{ERROR}} \text{ imperative-statement}].$$

1. Example: SUBTRACT cost FROM sales GIVING profit.
    a. Data in the area referenced by cost is subtracted from the data in the area referenced by sales.
    b. The answer is stored in the area referenced by profit, which may be an edited output field.
2. Example: SUBTRACT 5.00 FROM acct-in GIVING new-balance.
    a. The constant 5.00 is subtracted from acct-in.
    b. The answer is stored in the area referenced by new-balance.

XIV. EDITING/PICTURE Clause

A. Editing is accomplished in COBOL by special editing characters within the PIC clause. Editing should be specified only for output fields that are to be printed.
   1. Dollar sign
   2. Comma
   3. Decimal point

B. Example: 03 Amt-out PIC $9,999.99.

C. Zero suppression and asterisk-fill
   1. Z's are entered in PIC clause up to and including the point at which zero suppression is to stop.
   2. Z specifies that leading zeros of the indicated positions are to be replaced with spaces.
   3. Example: 03 amt-out PIC $Z,ZZZ.99.
   4. * specifies that leading zeros of the indicated positions are to be replaced by asterisks.
   5. Example: 03 check-amount PIC $*,**9.99.
   6. Z and * represent numeric characters that are to be suppressed or replaced when the digit is zero.
   7. Only characters that can precede either the Z or * in a PIC clause are the dollar sign, minus sign, plus sign, or comma.

D. Insertion characters

1. Use of an insertion character will cause that character to be placed in the corresponding position of the identifier specified when data are placed in that field.

2. The PICTURE clause must be large enough to hold both the data and the insertion characters.

3. Dollar sign, comma, and decimal point can be used as insertion characters only when the data are numeric.

4. Dollar sign

   a. A single symbol "$" in a PIC clause indicates that a dollar sign is to be inserted by the object program at the position occupied by the symbol.

   b. Several consecutive repetitions of the "$" indicate that the object program is to edit the data with a floating dollar sign, one that "floats" across the positions occupied by the consecutive symbols.

5. Commas

   a. When used in a PIC clause, a comma is inserted by the object program in the area referenced by the data-name specified.

   b. If the zero to the left of the comma has been suppressed, then the comma is either suppressed or replaced by the characters replacing the zeros.

6. Decimal point

   a. Object program will insert a period, to serve as an actual decimal point, at the position occupied by the symbol.

   b. Data placed into the identifier will be aligned so that the assumed decimal point corresponds to this actual decimal point.

   c. Decimal can occur in the PIC clause only once.

E. Plus and minus signs

1. Can be used at the beginning or end of the PIC clause

2. Data in a field that does not have a processing sign are considered positive.

3. When a minus sign appears at either end of a PIC clause, the object program indicates the sign in that character position.

    a. If the data are positive, a space is inserted.

    b. If the data are negative, a minus sign is inserted.

4. Floating minus sign

    a. Can be floated from the left-hand end of the PIC by placing this symbol in each leading position to be suppressed.

    b. If leading zero is replaced with a space, then either a space (if the number is positive) or a minus sign (if the number is negative) is placed in the position of the last suppressed zero.

5. Examples for minus signs

```
03  Balance            PIC -999.99.
03  Balance            PIC  999.99-.
03  Balance            PIC  ---.99.
```

6. When a plus sign appears at either end of the PIC clause, the object program indicates the sign of the data in that character position.

    a. If the data are positive, a plus sign is inserted (+).

    b. If the data are negative, a minus sign is inserted (-).

7. Examples of plus sign

```
03  Amt-due            PIC +999.99.
03  Amt-due            PIC  999.99+.
```

F. Character "B" in PIC clause

1. When a "B" occurs within a PIC clause, the object program will insert a blank (space) in each position occupied by this symbol.

2. Example: `03  soc-sec-no-pr      PIC 999B99B9999.`

G. Credit and debit symbols

a. CR and DB symbols at the right end of a PIC clause cause the object program to indicate the sign of the data in those locations with the CR or DB symbols.

2. CR - credit balance

   a. If the data are positive, two blanks are inserted.

   b. If the data are negative, CR is inserted.

3. DB - debit balance

   a. If the data are positive, two blanks are inserted.

   b. If the data are negative, DB is inserted.

4. CR and DB can be used only on the right end of the PIC clause.

5. Examples

Input record	PIC clause	Printed report
123V45	PIC $***.99CR	$123.45
-123V45	PIC $***.99CR	$123.45CR
-0123V45	PIC $$,$$$.99BCR	$123.45 CR
-004V56	PIC $$,$$$.99CR	$45.60CR
0012V56	PIC $*,***.99DB	$***12.56
-0012V56	PIC $*,***.99DB	$***12.56DB
-0012V56	PIC $*,***.99BDB	$***12.56 DB

H. Zero symbol/Symbol P (Implied position)

1. When the zero (0) appears in a PIC clause, the object program will insert a zero as an additional character at the place occupied by the zero symbol.

2. If the assumed decimal point location is not within the field, the symbol "P" is used to indicate each scaling position beyond either end of identifier-1.

3. Each P represents an implied position.

4. Examples

125	PIC 99900	12500
125	PIC 00999	00125
123	PIC 999PPPV	123000.
123	PIC VPP999	.00123

XV. MOVE Statements

A. When fields from which data are to be moved, and the field or fields to receive the data are defined as numeric:

1. Data are aligned by the actual or assumed decimal point.

2. Truncation or extension will take place on one or both ends of the data after it is moved to the receiving field if the fields are not the same length as the sending field.

3. When data are moved from one area to another, the field is edited according to the editing characters specified in the receiving field.

B. Examples

1. Alignment of assumed and actual decimal points

2. Truncation when moving a larger field to one that is too small

3. Extension, the filling with zeros when a smaller field is moved to a larger one

Data	Input PIC	Output PIC	Result
123V45	PIC 999V99	PIC 999.99	123.45
123V45	PIC 999V99	PIC 99.9	23.4
123V45	PIC 999V99	PIC 9(4).9(4)	0123.4500

XVI. Rounded Option

A. In decimals

1. Round upward if the low-order position is 5 or greater.

2. Drop the low-order digit when it is less than 5.

B. ROUNDED option is available with all arithmetic statements.

C. Truncation refers to the dropping of digits from an answer.

D. If, after decimal point alignment, the number of places to the right of the decimal point in the calculated result is greater than the number of places associated with the identifier whose value is to be set equal to the calculated result, truncation occurs.

E. When the ROUNDED option is specified, the least significant digit of the desired result is increased by 1 whenever the most significant digit of the excess is greater than or equal to 5.

F. Examples

Calculated Result	PIC	Value after Rounding	Truncated Value before Rounding
12.36	99V9	12.4	12.3
8.432	9V9	8.4	8.4
35.6	99V9	35.6	35.6
65.6	99V	66	65
.0055	V999	.006	.005

XVII. MULTIPLY Statement

A. Format

$$\underline{\text{MULTIPLY}} \quad \left\{\begin{array}{l}\text{identifier-1}\\ \text{literal-1}\end{array}\right\} \quad \underline{\text{BY}} \quad \left\{\begin{array}{l}\text{identifier-2}\\ \text{literal-2}\end{array}\right\}$$

[GIVING identifier-3] [ROUNDED] [ON SIZE ERROR

imperative-statement].

B. Multiplies 2 numeric data items and sets the value of identifier-2 or identifier-3 equal to the product

C. GIVING option

1. Identifier-1 and identifier-2 are multiplied, and the answer is developed in a work area.

2. The answer is then moved to identifier-3, which might be an edited output field.

3. If a literal is used in the identifier-2 position, then the GIVING option must be used.

4. When the GIVING option is omitted, the second operand must be an identifier which cannot be edited.

   a. The product replaces the value in the field specified by the identifier.

   b. Example

      MULTIPLY percent BY balance.

c. Percent is multiplied by balance and the answer is stored in the area referenced by balance.

d. Numeric literals

1) May be specified for either the multiplier or the multiplicand when the GIVING option is used.
2) Must be used as the multiplicand (identifier-1) if the GIVING option is not used.
3) Example

```
MULTIPLY 1.5 BY balance.
```

D. ROUNDED option

1. MULTIPLY rate-cd BY hours-cd GIVING total-pay ROUNDED.

2.
```
Rate-cd           PIC  99V99.
Hours-cd          PIC  99V9.
Total-pay         PIC 999V99.
```

3. The answer is rounded off to two decimal positions and stored in total-pay.

E. ON SIZE ERROR option

1. A size error condition exists when the number of integral places in the calculated result exceeds the number of integral places specified for the resultant data name.

2. Example

```
Total-pay           PIC 999V99.

   25.00  Rate-cd
   40.0   Hours-cd
1,000.00  Total-pay
```

a. Answer developed after rounding contains six digits.

b. The PIC is set to a maximum of five digits.

c. When the fields are multiplied, a size error condition will result.

3. If ON SIZE ERROR has been specified and a (size error) condition arises, the value of the resultant identifier is not altered, and the series of imperative-statements specified for the condition is executed.

4. Example

```
MULTIPLY rate-cd BY hours-cd GIVING total-pay
ROUNDED ON SIZE ERROR.
MOVE '*** excessive hours or pay rate ***' to
message-print.
```

   a. '***...***' is an example of a nonnumeric literal.

   b. Nonnumeric literal is a constant that may be used in any COBOL statement.

      1) Must be bounded by single quotation marks
      2) May consist of any combination of characters except quotation marks
      3) All spaces enclosed in quotation marks are included as part of the literal.
      4) May not exceed 120 characters
      5) Continuation of a nonnumeric literal
         a) Coding continues through column 72 on the first line.
         b) A hyphen is placed in column 7 of the continued line.
         c) A single quotation mark is placed in Area B preceding the continuation of the literal.
         d) All spaces at the end of the continued line and any spaces following the quotation mark in the continuation line are considered to be a part of the literal.

XVIII. DIVIDE Statement

A. Divides one numeric data item into another and stores the quotient in the specified field

B. Example

```
DIVIDE months INTO ytd-sales GIVING average-sales
ROUNDED ON SIZE ERROR MOVE '*** months employed
zero - - - calculation not performed ***' to
message.
```

   1. Months is divided into ytd-sales.

   2. The result is stored in average-sales.

C. Format notation

$$\underline{\text{DIVIDE}} \quad \left\{\begin{array}{l}\text{identifer-1}\\ \\ \text{literal-1}\end{array}\right\} \quad \underline{\text{INTO}} \quad \text{identifier-2} \quad \text{[ROUNDED]}$$

$$\text{[ON } \underline{\text{SIZE}} \ \underline{\text{ERROR}} \quad \text{imperative-statement].}$$

or

$$\underline{\text{DIVIDE}} \quad \left\{\begin{array}{l}\text{identifier-1}\\ \text{literal-1}\end{array}\right\} \quad \left\{\begin{array}{l}\underline{\text{INTO}}\\ \underline{\text{BY}}\end{array}\right\} \quad \left\{\begin{array}{l}\text{identifier-2}\\ \text{literal-2}\end{array}\right\}$$

$$\underline{\text{GIVING}}\ \text{identifier-3 [ROUNDED]}\quad [\underline{\text{REMAINDER}}\ \text{identifier-4}]$$

$$[\text{ON}\ \underline{\text{SIZE}}\ \underline{\text{ERROR}}\ \ \text{imperative-statment}].$$

D. Options with the division statement

1. ROUNDED and ON SIZE ERROR options may be used with the division statement.

2. When the GIVING option is omitted and the second operand is an identifier, division results in the value stored in the field specified by identifier-2 being set equal to the quotient.

3. Example: Without the GIVING option

   a. DIVIDE time INTO hours.

   b. Time is divided into hours, and the answer is stored in hours.

4. When the GIVING option is used, the results may be an edited output field.

5. A numeric literal may be specified as either the divisor or dividend when the GIVING option is used.

6. Example: With the GIVING option

   a. DIVIDE 12 INTO months GIVING monthly-average.

   b. Twelve is divided into months, and the answer is stored in monthly-average.

7. SIZE ERROR conditions

   a. The number of integral places in the calculated result exceeds the number of integral places specified for the resultant data name.

   b. Division by zero attempted.

XIX. COMPUTE Statement

A. Format notation

$$\underline{\text{COMPUTE}}\ \ \text{identifier-1}\ [\underline{\text{ROUNDED}}] = \left\{\begin{array}{l}\text{identifier-2}\\ \text{literal-1}\\ \text{arithmetic}\\ \quad\text{expression}\end{array}\right\}$$

$$[\text{ON}\ \underline{\text{SIZE}}\ \underline{\text{ERROR}}\ \text{imperative-statement}].$$

B. The compute statement assigns to a data item the value of a numeric data item, literal, or arithmetic expression.

C. The identifier specified to the left of the equal sign must be an elementary report, internal decimal, external decimal item, or an edited output item.

D. Arithmetic expressions in a COMPUTE statement

1. May consist of arithmetic operators, identifiers, and literals

2. Arithmetic operators

a. Addition (+)

b. Subtraction (-)

c. Multiplication (*)

d. Divison (/)

e. Exponentiation (**)

E. Each arithmetic operator must be preceded and followed by a space, including the equal sign.

F. Examples of the compute statement

1. Addition: COMPUTE total = regular + overtime.

a. Contents of regular and overtime are added.

b. The answer is stored in the area referenced by total.

2. Subtraction: COMPUTE balance = sales - returns.

a. Returns are subtracted from sales.

b. The answer is stored in balance.

3. Multiplication: COMPUTE pay = hours * rate.

a. Hours are multiplied by rate.

b. The answer is stored in pay.

4. Division: COMPUTE average = pay / months.

a. Pay is divided by months.

b. The answer is stored in average.

5. Addition and subtraction:

   COMPUTE net-pay ROUNDED = regular + overtime - deductions.

   a. Regular is added to overtime.

   b. The area referenced by deductions is subtracted from the sum of regular and overtime.

   c. The answer is rounded and stored in net-pay.

6. Exponentiation: COMPUTE volume = 4 / 3 * pi * R ** 3.

   a. Exponentiation means raising to a power.

      1) A^2 means A times A or A ** 2.
      2) A^3 means A times A times A or A ** 3.

   b. The division and multiplication operations are performed from left to right after the exponentiation.

   c. The answer is stored in volume.

7. Numeric literal: COMPUTE years = months / 12.

   a. 12 is divided into months.

   b. The answer is stored in years.

8. ROUNDED and ON SIZE ERROR options

   COMPUTE total-pay ROUNDED = regular + overtime - deductions ON SIZE ERROR GO TO error-routine.

   (NOTE: Size error condition applies only to the final result and not to any of the intermediate results.)

XX. Evaluating Arithmetic Expressions

A. Can be specified by parentheses

B. Example: A * B + C can be (A * B) + C or A * (B + C).

C. If parentheses are not written to specify the order of computation,

   1. All exponentiation is performed first.

   2. Then multiplication and division are performed from left to right.

3. Finally, addition and subtraction are performed from left to right.

    a. A * B / C is evaluated (A * B) / C.

    b. A / B * C is evaluated (A / B) * C.

D. Parentheses present:

1. Computation begins with the innermost set and proceeds to the outermost.

2. Items in parentheses will be evaluated in accordance with the above rules.

3. Results will be treated as if the parentheses were removed.

E. Examples

1. Correct usage

    a. COMPUTE depreciation-hold = (cost-cd - salvage-cd) / life-cd.

    b. Calculations within parentheses are performed first.

    c. That answer is then divided by life-cd to give a correct result.

2. Incorrect usage

    a. COMPUTE depreciation-hold = cost-cd - salvage-cd / life-cd.

    b. Because of the hierarchy of evaluation, the division operation will be performed first, dividing life-cd into salvage-cd.

    c. Then the subtraction would be performed, giving an incorrect result.

3. Double parentheses

    a. COMPUTE amount = principal * ((1 + rate) ** years).

    b. Calculations within the innermost parentheses are performed first; thus, 1 + rate is calculated first.

    c. 1 + rate would then be raised to the power specified by years.

    d. That answer would be multiplied by principal and stored in amount.

XXI. DISPLAY Statement

A. Used to print brief messages on the console typewriter, the printer, or card punch

B. Used to give instructions to the operator concerning error conditions that might occur during execution of a program or print end-of-job messages

C. In order to print a message on the console typewriter, an entry must be made in the Special-Names paragraph of the Configuration Section, as well as in the DISPLAY statement itself.

Example:

```
SPECIAL-NAMES.
    CONSOLE IS typewriter.
```

D. Format notation

```
SPECIAL-NAMES.
    [function-name-1 IS mnemonic-name]
    [function-name-2 IS mnemonic-name] . . .
```

1. Function-name-1 is one of a set of special names which describe a particular device or function to be performed.

2. Examples of function-names are CONSOLE and C01.

3. Mnemonic-name is a programmer-supplied word which is used in the DISPLAY or WRITE statement to reference the function-name, i.e., top-of-page or typewriter.

E. Format notation of DISPLAY statement

$$\text{DISPLAY} \quad \begin{Bmatrix} \text{literal-1} \\ \text{identifier-1} \end{Bmatrix} \quad \begin{bmatrix} \text{literal-2} \\ \text{identifier-2} \end{bmatrix} \quad \ldots$$

[UPON mnemonic-name].

1. When the UPON clause is included, the device is defined by the mnemonic-name which is included in the statement.

2. If the UPON clause is not included, the output will be written either on the typewriter console or printer, depending upon which computer is being used.

3. Maximum length of the message will normally be the maximum length record which can be printed on the particular device.

   Example:

```
SPECIAL-NAMES.
    CONSOLE IS typewriter.
```

4. DISPLAY 'error in processing Job 4' UPON typewriter.

XXII. Working-Storage Section

A. Used to reserve areas of storage for "counters," which will be used to accumulate totals and for calculations

B. Data that is to be added into a counter must be numeric and cannot contain any edit symbols (dollar sign, comma, decimal point, etc.).

C. Steps in taking a final total

   1. Record is read into input area.

   2. A "1" is added to counter.

      a. Counter area is established in Working-Storage Section.

      b. After all records have been processed, counter will contain the number of records processed.

   3. Example: COMPUTE depreciation-hold = (cost-cd - salvage-cd) / life-cd.
      ADD depreciation-hold TO depreciation-total.

   4. The salvage value is subtracted from the item value, and the answer is stored in the depreciation-hold area, which is established in the Working-Storage Section.

   5. The contents of depreciation-hold are then added to depreciation-total field, also defined in working-storage.

      (NOTE: After all records have been processed, the depreciation-total field will contain the total of all of the depreciation values calculated.)

   6. Fields are moved to the print area, edited as required, and printed.

D. Working-Storage entries

   1. 77 card-counter PIC S999 VALUE IS ZERO USAGE IS COMP-3.

   2. 77 depreciation-total PIC S9(6)V99 VALUE ZEROES COMP-3.

   3. 77 depreciation-hold PIC S9(5)V99 VALUE ZEROES COMP-3.

E. Working-Storage is used to describe areas of storage reserved for intermediate processing of data.

   1. Consists of a series of record description entries, each of which describes an item in a work area

   2. An independent working-storage entry describes a single item that is not subdivided and is not itself a subdivision of some other item.

      a. Each independent item is defined in a separate record description entry.

      b. Begins with the special level number 77

      c. All 77 levels must precede any items having any of the level numbers 01 through 49.

XXIII. Sign

A. Character 'S' in PIC clause

B. Indicates the presence of an operational sign

C. Must be extreme left character of the PIC

D. If a field contains a sign to identify negative amounts, an 'S' must be included as part of the PIC clause.

   1. For answers developed by the execution of COBOL statements, the compiler will develop a negative sign if and only if an 'S' is written in the PIC.

   2. If an 'S' is not written, answers will have a sign interpreted as positive.

   3. If there is a possibility of a result being negative, an 'S' must be included in the PIC clause.

E. The programmer should include a sign in a PIC clause unless absolute values are desired.

   1. Use of unsigned fields increases the possibility of errors if fields or answers developed can be negative.

2. Addit[illegible]ode is generated to control the sign if a sig[illegible]s not specified in PIC.

3. For numeric fields specified as unsigned, the COBOL compiler insures that a sign is present so that the values are treated as absolute.

XXIV. VALUE Clause

A. Used to specify the initial value of working-storage items

B. Figurative constant

1. ZERO or ZEROES or ZEROS

2. SPACE or SPACES

C. VALUE IS ZERO or VALUE IS SPACES

1. IS is noise word and may be omitted.

2. Necessary to insure that the contents of the area referenced by the data items are initialized (set to zero or spaces) before execution of the program

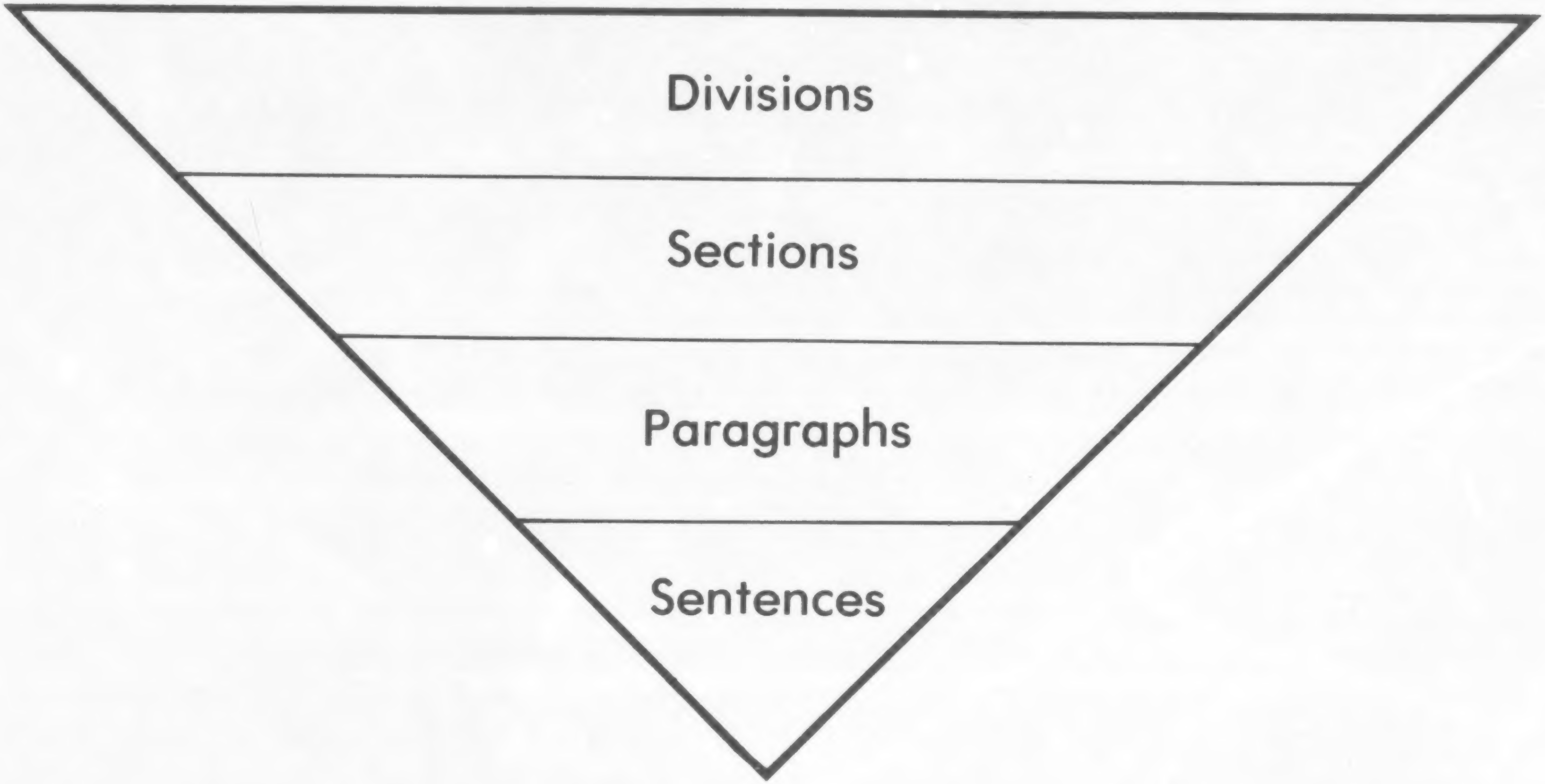
3. If values are not initialized, no assumption should be made regarding the initial contents of an item in working-storage.

4. VALUE [IS] literal.

5. The size of the literal given in a VALUE clause must be less than or equal to the size of the item as given in the PIC clause, with the provision that the literal must also include leading or trailing zeros to reflect P's in the PIC clause.

6. If the literal specified is a figurative constant, the size of the item generated is the size specified in the PIC clause.

The Hierarchy of Cobol Structure



Divisions

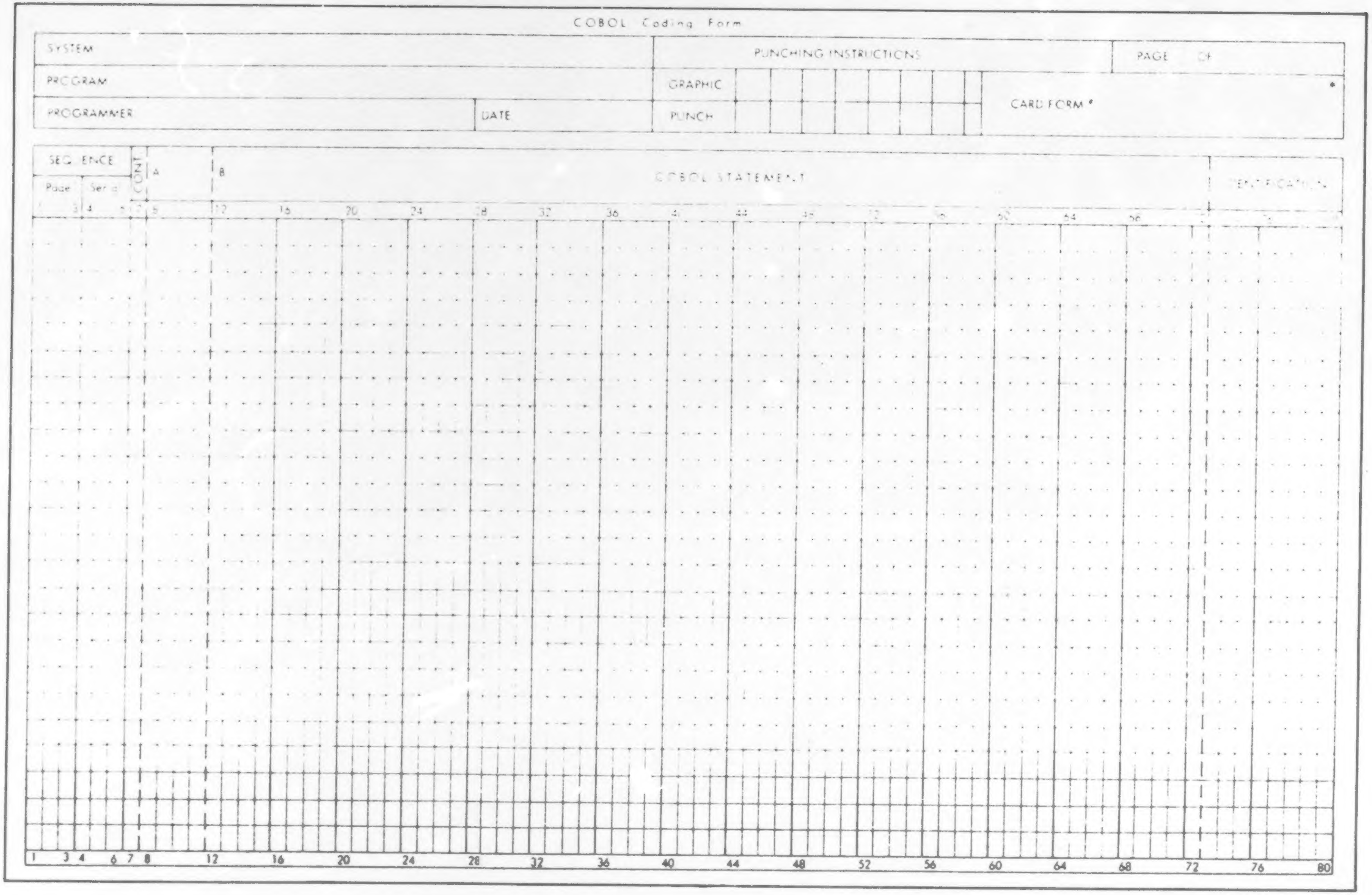
Sections

Paragraphs

Sentences

TM-IX-1

COBOL Coding Form



COBOL Coding Form

SYSTEM

PROGRAM

PROGRAMMER

DATE

PUNCHING INSTRUCTIONS

PAGE OF

GRAPHIC

PUNCH

CARD FORM #

SEQUENCE

Page Serial

CONT

A

B

COBOL STATEMENT

IDENTIFICATION

1 3 4 6 7 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80

COBOL Divisions 1 and 2

1. Identification Division

Program ID.

Total-of-15-numbers.

2. Environment Division

CONFIGURATION SECTION

Source Computer. CYBER-74.

Object Computer. CYBER-74.

INPUT-OUTPUT SECTION

File Control.

Select Data-File Assign to
Card-Reader-FZ.

Select Total-File Assign to
Printer-FZ.

TM-IX-4

Data Division Concept

PURPOSE: All files are specified in detail.

File Section

The Input And Output Files

Working – Storage Section

The Intermediate or Working Files

The Data Division

```
FILE SECTION
FD      DATA-FILE
        LABEL RECORDS ARE OMITTED
        DATA RECORD IS DATA-CARD.
01      DATA-CARD.
        02   DATA-VALUE       PICTURE IS 9 (6) V99.
        02   FILLER           PICTURE IS X(72).
FD      TOTAL-FILE
        LABEL RECORDS ARE OMITTED
        DATA RECORD IS TOTAL-LINE .
01      TOTAL-LINE.
        02   FILLER           PICTURE IS X.
        02   TITLE            PICTURE IS X(12).
                              VALUE IS 'THE TOTAL IS'.
        02   FILLER           PICTURE IS X(2).
        02   TOTAL-VALUE      PICTURE IS 9(13) V99.
        02   FILLER           PICTURE IS X(103).
WORKING-STORAGE SECTION
77      RUNNING-TOTAL         PICTURE IS 9(13)V99
                              VALUE IS 0.
```

The Procedure Division

THE PROCEDURE DIVISION TELLS THE COMPUTER HOW TO MANIPULATE THE INPUT DATA TO GENERATE THE DESIRED OUTPUT.

```
BEGIN-JOB.
        OPEN INPUT DATA-FILE
        OUTPUT TOTAL-FILE.
MAIN-LOOP.
        READ DATA-FILE AT END GO TO PRINT-ROUTINE.
        ADD DATA-VALUE TO RUNNING-TOTAL.
        GO TO MAIN-LOOP.
PRINT-ROUTINE.
        MOVE SPACES TO TOTAL-LINE.
        MOVE RUNNING-TOTAL TO TOTAL-VALUE.
        WRITE TOTAL-LINE.
END-OF-JOB.
        CLOSE DATA-FILE
        TOTAL-FILE.
        STOP RUN.
```

COBOL PROGRAMMING
UNIT IX

ASSIGNMENT SHEET #1: FIELD IDENTIFICATION AND PIC STATEMENTS

Directions: Complete the following exercises as directed.

A. The following fields are to be defined in a program. Indicate whether each should be identified as Alphabetic (A), Numeric (9), or Alphanumeric (X).

____1. A social security number

____2. A person's name

____3. City, state, and ZIP

____4. A field where gross pay is to be accumulated

B. Data pictures and corresponding input data are presented below. How will each item of data be stored in the input area?

Picture	Input Data	Read
99V9	125	1. ____________________
V999	014	2. ____________________
9(4)V9	28001	3. ____________________
999V99	76543	4. ____________________
99V999	76543	5. ____________________

C. PICTURE Z,ZZ9.99 is given in a program. How will each of the following fields be interpreted according to the PICTURE?

____________________1. 123876

____________________2. 001352

____________________3. 074721

____________________4. 000033

____________________5. 006189

ASSIGNMENT SHEET #2: COBOL CODING AND STATEMENTS

Directions: Complete the following exercises as directed.

A. Write a description of the record format if input fields in each record contain the following data. Your description should be complete enough to be used in a COBOL program.

Employee number	2-10
Employee name	11-32
Employee job code	40-44
Sex	49
Age	53-54
Year first employed	57-58

B. Write a COBOL statement for each of the following desired calculations.

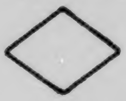
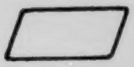
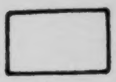
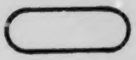
1. A x B; result in C ______________________________
2. Y x 3.14; result in R ______________________________
3. X ÷ Y; result in Z ______________________________
4. 8.91 ÷ D; result in D ______________________________

COBOL PROGRAMMING
UNIT IX

ASSIGNMENT SHEET #3: COBOL RELATED TO FLOWCHARTS AND PRINTED OUTPUT DESIGN

Directions: Complete the following exercises as directed.

A. Match each of the COBOL statements in Column B with the flowchart symbol it would replace in Column A.

Column A	Column B
____1. 	a. ADD WORK TO SUM-TOTAL GIVING SUM-OUT.
____2. 	b. OPEN INPUT IN-FILE.
____3. 	c. WRITE OUTPUT-RECORD FROM HOLD-AREA.
	d. IF EMPLOYEE-CODE = 'EM. . . . . .'.
____4. 	e. STOP RUN

B. Determine the number of printing lines available under these conditions:

1. Paper is 8 1/2 inches vertical measure.
2. Printing uses 8 lines per vertical inch.
3. Top margin requires 1 vertical inch.
4. Bottom margin requires 3/4 vertical inch.
5. Two (2) headings each require 5 lines.

COBOL PROGRAMMING
UNIT IX

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET #1:

A. 1. A or X
   2. A or X
   3. X
   4. 9

B. 1. 12.5
   2. .014
   3. 2800.1
   4. 765.43
   5. 76.543

C. 1. 1,238.76
   2. 13.52
   3. 747.21
   4. 0.33
   5. 61.89

ASSIGNMENT SHEET #2:

A.
```
01 INPUT-RECORD
   02 FILLER                 PICTURE X.
   02 EM-NUMBER              PICTURE X(9).
   02 EM-NAME                PICTURE X(22).
   02 FILLER                 PICTURE X(7).
   02 EM-CODE                PICTURE X(5).
   02 FILLER                 PICTURE X(4).
   02 SEX                    PICTURE X.
   02 FILLER                 PICTURE X(3).
   02 AGE                    PICTURE XX.
   02 FILLER                 PICTURE XX.
   02 YEAR-EMP               PICTURE XX.
   02 FILLER                 PICTURE X(22).
```

B. 1. MULTIPLY A BY B GIVING C.
   2. MULTIPLY Y BY 3.14 GIVING R.
   3. DIVIDE Y INTO X GIVING Z.
   4. DIVIDE D INTO 8.91.

ASSIGNMENT SHEET #3:

A. 1. 4
   2. 2 and 3
   3. 1
   4. 5

B. 68 lines total
 - 8 top margin
 - 6 bottom margin
 -10 headings
 44 total printing lines available

COBOL PROGRAMMING
UNIT IX

EXAMINATION

1. Match each of the terms in Column B with the correct definition in Column A.

Column A	Column B
____a. A reserved word which transfers program control	1. ASSIGN
____b. A reserved word used to print brief messages on the console typewriter, the printer, or card punch	2. CLOSE
____c. A reserved word used when some characters in a record are not used in processing.	3. DISPLAY
____d. A reserved word used to relate a file to a particular input-output device	4. FILLER
____e. A reserved word used to specify the initial value of working-storage items	5. GO TO
____f. A reserved word which terminates processing of units or files.	6. OPEN
____g. A reserved word which makes an area available for development of input-output files	7. VALUE

2. In the area at the right of the column descriptions below, supply the correct headings for a COBOL coding form.

a. Columns 1 - 3 ______________________________

b. Columns 4 - 6 ______________________________

c. Column 7 ______________________________

d. Columns 8 - 11 ______________________________

e. Columns 12 - 72 ______________________________

f. Columns 73 -80 ______________________________

3. Define each of the following factors used in format notation.

   a. Reserved words ______________________________

   b. Noise words ______________________________

   c. Brackets ______________________________

4. List six rules for forming file-names or data-names.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

   f. ______________________________

5. COBOL programs use four separate and distinct divisions. Select the correct sequence of divisions from the choices below. Place an "X" in the blank at the left of your answer.

   ____a. Data, Environment, Identification, Procedure

   ____b. Identification, Environment, Data, Procedure

   ____c. Identification, Data, Procedure, Environment

   ____d. Procedure, Data, Environment, Identification

6. List the seven (7) notations in correct order which are frequently used in format notation in the Identification Division.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

   f. ______________________________

   g. ______________________________

7. Compare in generalities the information presented in the Configuration and Input-Output Sections of the Environment Division of a COBOL program.

8. Describe the purpose of the File Section in the Data Division of a COBOL program.

9. List three (3) different procedures which can be used in the Procedure Division to solve a program.

   a.

   b.

   c.

10. Write a correct COBOL statement to accomplish each of the three following situations in the Procedure Division.

    a. Prepare the input file called "sun" to make it available for processing the first input record.

    b. Move the area "star" to an area called "moon."

    c. Transfer control to a program portion called 060-END.

11. A "9" or a "V" can be used in the PIC clause for numeric data. Briefly describe the use of each character.

    a. "9"

    b. "V"

12. Explain the purpose of the GIVING and TO options in ADD statements.

    a. GIVING -

    b. TO -

13. Explain how the calculation would be performed in this statement: SUBTRACT discount FROM gross GIVING net.

14. Show how the numeric output would look based on these two PIC clauses.

    a. PIC $ZZ,ZZZ.99.   DATA 62.50   OUTPUT ______________

    b. PIC $**,***.99.   DATA 62.50   OUTPUT ______________

15. Give the term applied when data are moved to a field that is too small. ______________________

16. Distinguish between rounding and truncation.

    a. Rounding -

    b. Truncation -

17. Write a MULTIPLY statement with the GIVING option which will multiply A times B with the answer being stored in C.

18. Write a DIVIDE statement that will divide A by B with the answer stored in C.

19. Write a COMPUTE statement that will calculate average monthly sales for a year.

20. Select by placing an "X" in the blank at the left the correct sequence of evaluating arithmetic expressions.

____a. Exponentiation, division, subtraction, parentheses

____b. Addition, multiplication, exponentiation, parentheses

____c. Parentheses, division, subtraction, exponentiation

____d. Parentheses, exponentiation, multiplication, subtraction

21. If the operator wishes a message to appear on a screen or printer, a reserved word is used. That reserved word is ______________________________.

22. Explain why a WORKING-STORAGE SECTION is necessary.

23. Explain the purpose of an "S" in a PIC clause.

24. Explain the use of a VALUE clause.

COBOL PROGRAMMING
UNIT IX

ANSWERS TO EXAMINATION

1. a. 5
   b. 3
   c. 4
   d. 1
   e. 7
   f. 2
   g. 6

2. a. Page sequence
   b. Serial (line numbers)
   c. Continuation/comments
   d. Area A
   e. Area B
   f. Identification

3. Reserved words are words with preassigned meanings which are not used for other purposes. Source materials usually capitalize reserved words.

   Noise words are words which make code more readable. They are capitalized but not underlined.

   Brackets are items enclosed which may be used or omitted. Their use depends on the program requirements.

4. a. 1 - 30 characters in length
   b. May use A - Z, 0 - 9, and hyphen
   c. Must not start or end with a hyphen
   d. Must contain at least one letter
   e. May not be reserved words
   f. May not contain embedded blanks

5. B is correct.

6. PROGRAM-ID, AUTHOR, INSTALLATION, DATE-WRITTEN, DATA-COMPILED, SECURITY, REMARKS

7. Configuration section identifies the computer on which the program is to be compiled and executed. Input-output section contains information on file control and I/O devices to be used.

8. File section describes the content and organization of the files to be processed.

9. Computations
   Logical decisions
   Input/output

10. a. OPEN [INPUT SUN].
    b. MOVE sun TO moon.
    c. GO TO 060-END.

11. "9" - Used to indicate that a field is to be treated as a numeric field.

    "V" - Used to tell compiler where in the numeric field to locate the decimal point.

12. a. GIVING - Answer to addition is stored in identified field following the reserved word GIVING.
    b. TO - Identified field following TO is added to other identified fields and answer replaces identified field following TO.

13. Data in field, discount, is subtracted from data in field, gross, and answer is stored in field, net.

14. a. $ 62.50
    b. $****62.50

15. Truncated

16. a. Rounding refers to the process of rounding up if the low-order position is 5 or more or dropping a low-order digit if less than 5.
    b. Truncation is the dropping of a low-order digit or digits regardless of size.

17. MULTIPLY A BY B [GIVING C].

18. DIVIDE A BY B [GIVING C].

19. COMPUTE average = total-sales / 12

20. D is correct.

21. DISPLAY

22. Areas of storage need to be reserved for accumulation of totals and for calculations.

23. The "S" must be included if negative numbers are used or calculated.

24. The VALUE clause specifies the initial value of the contents of an item in working-storage.

CAREERS IN DATA PROCESSING
UNIT X

UNIT OBJECTIVE

After completion of this unit, students should be able to discuss characteristics needed for data processing careers, the various careers available in data processing, and the future in these types of careers.

SPECIFIC OBJECTIVES

After completion of this unit, students should be able to:

1. Name the three characteristics desirable in all data processing employees.
2. Match entry-level skills needed for employment with an appropriate example.
3. Name three places where you could receive training in data processing.
4. List three careers in manual data processing and give a brief description of the duties performed.
5. List three careers in mechanical data processing and give a brief description of the duties performed.
6. Discuss at least five careers in computer data processing.
7. Name and discuss three things that will affect the future in data processing.
8. Discuss two characteristics of the office of the future.
9. Discuss the outlook for a career in data processing.

CAREERS IN DATA PROCESSING
UNIT X

SUGGESTED ACTIVITIES

I. Instructor
   A. Administer pretest.
   B. Provide students with objective sheet.
   C. Provide students with information and assignment sheets.
   D. Make transparencies.
   E. Discuss unit and specific objectives.
   F. Discuss information and assignment sheets.
   G. Give evaluation.

II. Student
   A. Complete pretest.
   B. Read objective sheet.
   C. Study information sheet.
   D. Complete assignment sheets.
   E. Take examination.

INSTRUCTIONAL MATERIALS

I. Included in this unit:
   A. Objectives
   B. Notes to the instructor
   C. Information sheets
   D. Transparency masters
      1. TM-X-1: Computer Personnel
      2. TM-X-2: Systems Analyst
      3. TM-X-3: Programmer

        4. TM-X-4: Computer Operator
        5. TM-X-5: Data Entry
        6. TM-X-6: Manager: Electronic Data Processing
        7. TM-X-7: Wanted: DP Professionals for the 80's

    E. Assignment sheets

        1. AS-X-1: Job Word Search: Business and Office Cluster
        2. AS-X-2: Interest Test
        3. AS-X-3: Programming Aptitude Test
        4. AS-X-4: Achievement Test
        5. AS-X-5: Research Project

    F. Answers to assignment sheets

    G. Pretest

    H. Evaluation

    I. Answers to pretest and evaluation

II. References

A. 1982 Computer Salary Survey and Career Planning Guide. Source EDP Personnel Services, 515 Olive Street, St. Louis, MO 63101, 1982.

B. Robichaud, Beryl; Muscat, Eugene; and Hall, Alix-Marie. Introduction to Data Processing. New York: McGraw-Hill Book Co., 1977.

CAREERS IN DATA PROCESSING
UNIT X

NOTES TO THE INSTRUCTOR

Throughout this unit emphasize the importance of basic skills, such as penmanship, oral communications, math, spelling, keying accuracy and logic. Also, emphasize desirable personal characteristics, such as patience, persistence, and precision. These factors - basic skills and personal characteristics - are necessary for employees to be successful in a data processing career.

Salary ranges are approximate and may vary from region to region, city to city, and company to company. Also, salaries change frequently so personal investigations may be necessary if exact salaries are desired. Try to emphasize a hierarchy of data processing positions based on salary estimates to give students an idea of advancement possibilities.

CAREERS IN DATA PROCESSING
UNIT X

INFORMATION SHEET

I. Characteristics Desirable in All Data Processing Employees

   A. Patience

   B. Persistence

   C. Precision

II. Entry-level Skills Needed for Entry-level Employment

   A. Communications

      1. Written - neat handwriting, etc.

      2. Oral - ability to speak clearly and concisely

   B. Numeric skills - basic math

   C. Manual dexterity - keying skills

   D. Clerical speed and accuracy

   E. Problem-solving skills

III. Education

   A. Schools and colleges

   B. Specialized programs

   C. Technical schools - provide practical training in shortest time possible

   D. Industrial training (apprenticeships) on-the-job training with instruction

   E. Military service - occupational training while earning a steady income

IV. Careers in Manual Data Processing

   A. Mail clerk - processes incoming and interoffice mail

   B. Clerk/typist - transfers data from source documents to business forms

   C. Accounting clerk - helps keep track of financial records

D. File clerk - organizes and stores documents so they can be found quickly

E. Input/output clerk - keeps track of the work that comes in and goes out of the data processing department

F. Microfilm operator - catalogs the filmed documents and stores the film

V. Careers in Mechanical Data Processing

A. Addressing machine operator - prints address labels for outgoing mail

B. Calculating or accounting machine operator - performs simple arithmetic needed for checking

C. Word processing operator - skilled typist who uses an automatic typewriter

D. Copy machine operator - operates duplicating machines, mimeograph machines, xerography machines, etc.

VI. Careers in Computer Data Processing (Refer to TM-X-1 and AS-X-1.)

A. Analyst (Refer to TM-X-2.)

1. Responsibilities - will find ways of setting up and completing data processing work as simply, inexpensively, and quickly as possible, i.e., defining the problem, interacting with the users, and designing the program

2. Trends - will continue to be in exceptionally high demand - more alternatives open to this group than any other in the field

3. Requirements - usually a college degree with work experience in hardware and software

4. Salary range - $24,000 - $55,000 (could go higher; depends on experience)

B. Programmer (Refer to TM-X-3.)

1. Responsibilities

a. Systems programmer creates and/or maintains operating systems, monitors, data base packages, compilers, assemblers, utility programs, etc.

b. Applications programmer (business and scientific) - performs coding, testing, debugging, documentation, and implementation of commercially-oriented systems

2. Trends - high level of demand will continue

3. Requirements - usually degree in computer science

4. Salary range - $20,000 - $36,100 (could go higher)

C. Data base specialist

1. Responsibilities - design and control the use of an organization's data resources; be responsible for procedures to insure data security, data base backup and recovery, and elimination of data redundancy; utilize facilities of the Data Base Management System (DBMS)

2. Trends - demand increasing due to projected growth in number of DBMS installations nationally

3. Requirements - technical knowledge of programming and of systems software

4. Salary range - $26,800 - $38,500

D. Documentation specialist

1. Responsibilities - document programs and systems as well as user manuals, marketing brochures, and other documentation required to properly utilize computing systems

2. Trends - demand will grow due to the increased use of time-sharing and distributive processing systems

3. Requirements - increased knowledge of sophisticated documentation techniques as well as increased technical knowledge of hardware, applications, or programming languages

4. Salary range - $20,100 - $28,600

E. Systems auditor

1. Responsibilities - perform detailed evaluation of existing and proposed systems and operational procedures and report findings to upper level management along with specific recommendations

2. Trends - growth in size and complexity of data processing systems has resulted in a strong need for these professionals

3. Requirements - college degree preferred - MBA or CPA desired

4. Salary range - $23,800 - $36,000

F. Other programming titles - (salary range from $10,000 - $45,000)

1. Programmer/Analyst

2. Senior computer programmer

3. Junior computer programmer

4. Programming trainee

G. Computer operations - (salary range from $8,000 - $45,000) (Refer to TM-X-4.)

1. Computer operations manager

2. System/Console operator

3. Peripheral equipment operator

4. Computer operations trainee

H. Computer input (data entry) - (salary range from $7,735 - $25,000) (Refer to TM-X-5.)

1. Supervisor

2. Key-punch operator

3. Key-to-storage operator

4. On-line terminal operator

I. Equipment selection and maintenance - (salary range from $12,500 - $25,000)

1. Equipment analyst

2. Equipment technician

J. Data processing manager - (salary range from $14,000 - $55,000) - oversees entire data processing operation (Refer to TM-X-6.)

VII. The Future in Data Processing (Refer to TM-X-7.)

- A. Increased use of word processing
- B. Increased use of COM (computer output microfilm)
- C. Computer improvements
  - 1. Price - declining
  - 2. Reliability
  - 3. Speed
  - 4. Size
  - 5. Convenience of installation
  - 6. Information storage capacity
  - 7. Ease of use
- D. Terminals
  - 1. Enter data directly into computer
  - 2. Retrieve information from the computer
- E. Data communications
  - 1. Telephone lines
  - 2. Satellites
  - 3. Microwave communications facilities
- F. Industrial automation
  - 1. CAM systems - Computer Aided Manufacturing
  - 2. CAD - Computer Aided Design

VIII. The Office of the Future

- A. The trend towards the computerized office
  - 1. Disappearance of paper documents
    - a. Microfilm and microfiche
    - b. Computer mass storage units
    - c. Word processing storage devices
  - 2. Increased use of terminals

B. New areas for computer processing

1. Medicine

2. Education

3. Home information networks

IX. Outlook for a Career in Data Processing (Refer to AS-X-5.)

A. Growth in office jobs

B. Future office career opportunities

1. Design computer systems

2. Write computer programs

3. Operate the equipment

4. Repair hardware

5. Interact with computer (noncomputer personnel)

C. Where to obtain career information

1. Government agencies and community associations

a. Superintendent of Documents
Government Printing Office
Washington, DC 20402

2. Trade and professional associations

a. Public Information
American Federation of
Information Processing Societies (AFIPS)
Suite 800
1815 N. Lynn St.
Arlington, VA 22209

b. Association for Computing Machinery (ACM)
1133 Sixth Ave.
New York, NY 10036

D. Career counseling

1. Interest tests - compare likes and dislikes (Refer to AS-X-2.)

2. Aptitude tests - measure how well suited for training in a particular skill (Refer to AS-X-3.)

3. Achievement tests - assess skills in a certain area or level of performance (Refer to AS-X-4.)

E. Career application (Refer to AS-X-5.)

COMPUTER PERSONNEL

There has *never* been a better time to seek a position change. Our clients have immediate requirements for the following:

COMMERCIAL & SCIENTIFIC

Mgrs. of Data Processing	$14-25K
Asst. Mgrs. of Data Proc.	$14-18K
Tech. Assts. to the Mgr.	$10-14K
Mgrs. of Systems Analysis	$12-22K
Lead Systems Analysts	$10-20K
Sr. Systems Analysts	$10-14K
Jr. Systems Analysts	$ 8-10K
Mgrs. of Programming	$13-16K
Software Programmers	$10-15K
Lead Programmers	$11-14K
Sr. Programmers	$ 9-15K
Jr. Programmers	$ 8-11K
Mgrs. of Computer Oprns.	$10-20K
Lead Computer Operators	$ 9-12K
EDP Consultants	$12-15K
EDP Sales Reps.	$12-15K
Systems Reps.	$10-12K
Service Center Mgrs.	$18-20K
Service Center Sales Reps.	$10-12K

OPERATIONS RESEARCH

Lead O/R Analysts	$15-20K
Sr. O/R Analysts	$12-20K
Jr. O/R Analysts	$ 9-15K
O/R Consultants	$15-20K

Systems Analyst

The "ELITE" of Computer Experts

ABILITY

EDUCATION

TRAINING

HARD WORK

ORGANIZATION

EXPERIENCE

Programmer

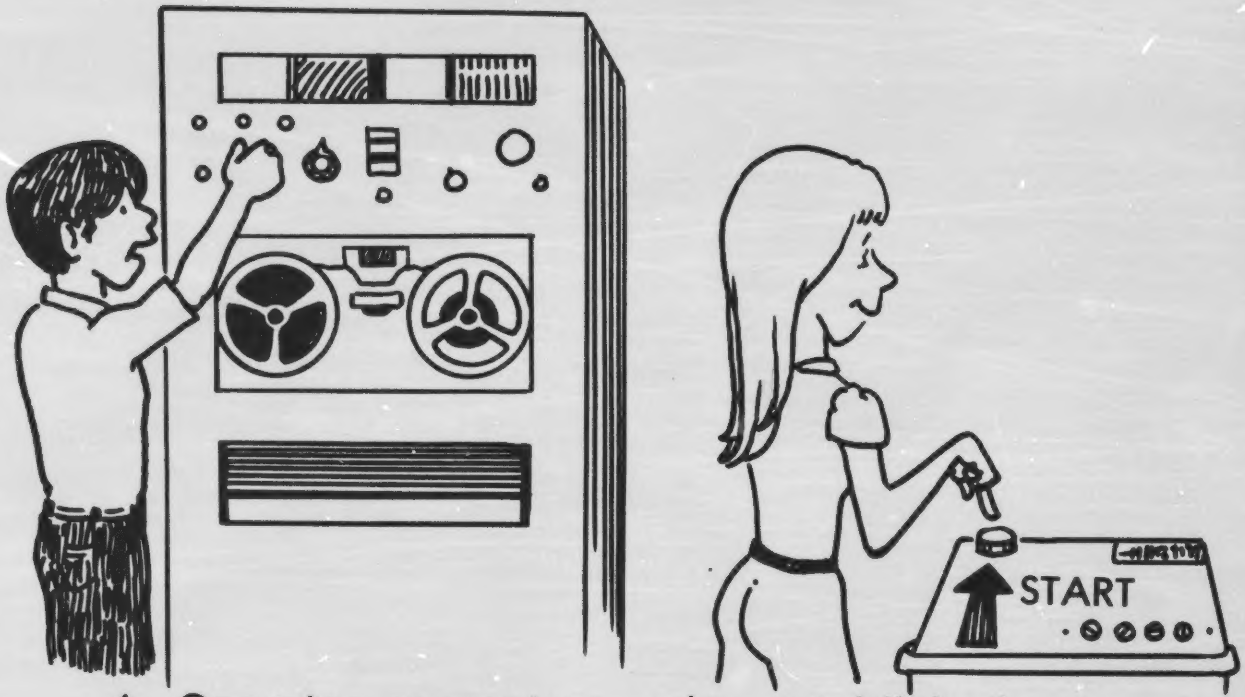
- Plans how computer must be programmed to produce desired information

- Develops flowchart to represent business problem
- Determines kind of data needed to solve the problem

- Tests completed program
- "Debugs" the program

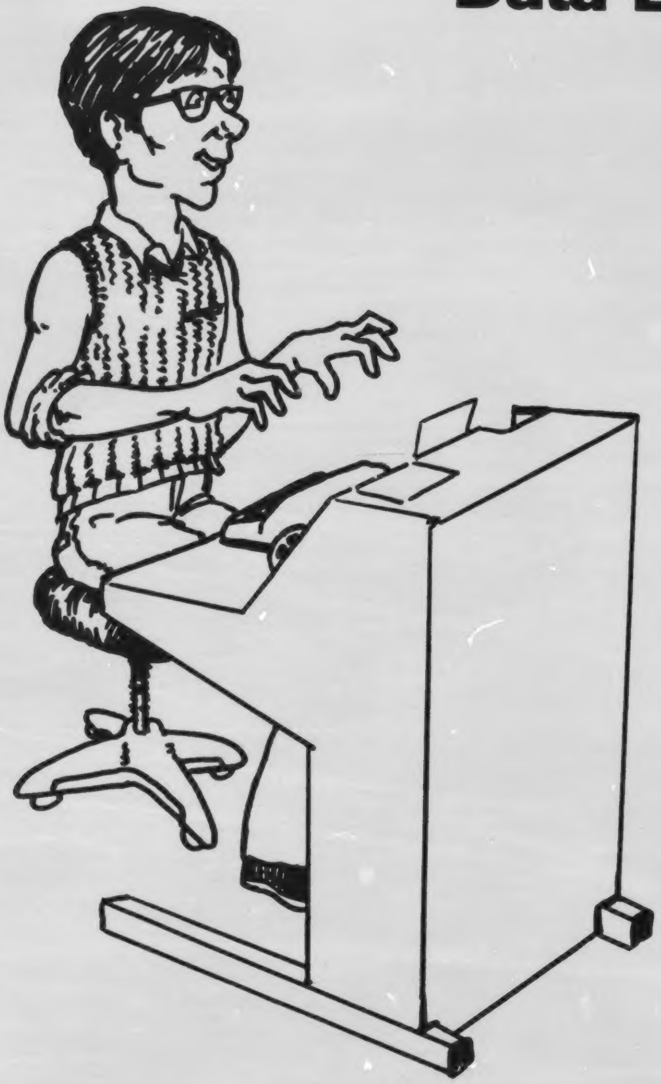
TM-X-4

Computer Operator



1. Operates computers, using established programs
2. Prepares input data for entry
3. Loads and unloads programs
4. Manipulates control switches on the computer consoles
5. Observes lights on consoles and other devices in the computer system, detecting processing and equipment errors, and making normal adjustments
6. Maintains operating records

Data Entry



Uses a machine similar to a typewriter

Watches screen to detect faults

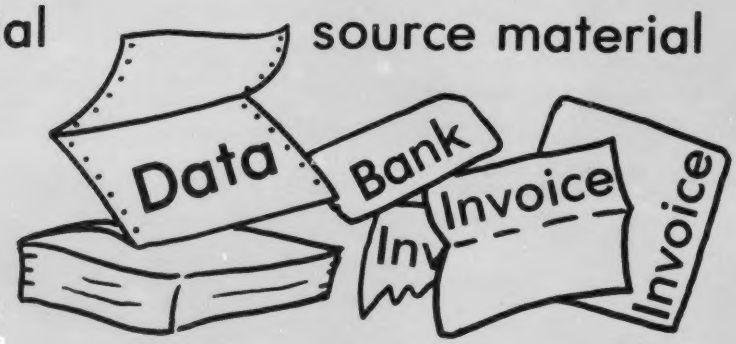
Must have good eyesight

Sometimes night or evening work

Works from source material

Codes the material

Works rapidly and accurately


Data
Bank
Inv
Invoice
Invoice

Manager: Electronic Data Processing

Directs and coordinates planning and production activities of electronic data processing division

Consults with management to define boundaries and priorities of tentative projects

Discusses equipment acquisitions

Determines specific information requirements of management, scientists, or engineers

Allocates operating time of computer systems

Assigns, schedules, and reviews work

Interprets policies, purposes, and goals to subordinates

TM-X-7

WANTED

WANTED

Data Processing Professionals for the 80's

Programmers will be in short supply throughout the 1980's.

Three major reasons for continued demand:

Inertia of software developed over the last thirty years

Pressure to implement new applications

Continued shortage of well-trained computer professionals

EDP problems of "overutilization of undereducated people"

Projected annual production of computer science graduates in mid-1980's will not meet demand

11,500 bachelor's degrees

6,000 master's degrees

470 doctorates

Large number of want ads in almost every city

Average vacancy rate of 17 percent in recent survey of 289 installations

CAREERS IN DATA PROCESSING
UNIT X

ASSIGNMENT SHEET #1: JOB WORD SEARCH: BUSINESS AND OFFICE CLUSTER

Directions: Seek and find 15 business/office occupations. They are hidden across, up and down, on more than one line, and in L-shapes.

B A N K A T N A T N U O C C A A B C D
O E F R G H I J E K L M L S N N O P Q
O R S E T U V W L X Y Z E Y A K A B C
K D E L F G H I L J K L R S L R M N O
K P S C L E R K E Q R S K T Y E U V W
E X N T Y Z A B R K N A B E S L C Y D
E E O Y F G H I J K L M N M T C O R P
P C I P E R S O N N E L Q S R E S A T
E I T I U W O R K E R V W X Y L Z T A
R L A S B C D E F G H I J K L I M E N
O B L T O F F I C E P Q R S T F U R V
W U E X Y Z A B C M A C H I N E D C E
F P R G H I J K L O P E R A T O R E M
O W O R K E R R E C E P T I O N I S T
S T A T I S T I C A L C L E R K P Q R
S T U R O T A R E P O R E T U P M O C
B I L L I N G C L E R K U W X Y Z A B

JOBS
ACCOUNTANT
BANK CLERK
BANK TELLER
BILLING CLERK
BOOKKEEPER
CLERK TYPIST
FILE CLERK
OFFICE MACHINE OPERATOR
PERSONNEL WORKER
PUBLIC RELATIONS WORKER
RECEPTIONIST
SECRETARY
STATISTICAL CLERK
SYSTEMS ANALYST
COMPUTER OPERATOR

CAREERS IN DATA PROCESSING
UNIT X

ASSIGNMENT SHEET #2: INTEREST TEST

Directions: When interviewed by the Data Help Employment Agency, you are given an interest test. Interest tests enable you to compare your likes and dislikes with those people who have done well in their careers. Below is a checklist of some of the interest test questions. Complete the checklist.

INTEREST CHECKLIST

Place a check in the column to the right that indicates your interest in the following activities. Consider each answer carefully.

	Like	Not Sure	Dislike
1. Using your hands	____	________	_______
2. Working with numbers	____	________	_______
3. Doing many different things	____	________	_______
4. Helping others	____	________	_______
5. Working indoors	____	________	_______
6. Creating something new	____	________	_______
7. Seeing the results of your effort	____	________	_______
8. Exercising leadership	____	________	_______
9. Working overtime hours	____	________	_______
10. Learning new skills	____	________	_______

CAREERS IN DATA PROCESSING
UNIT X

ASSIGNMENT #3: PROGRAMMING APTITUDE TEST

Directions: You inquire about the opportunity to be trained as a computer programmer, and your employer agrees to give you a programming aptitude test. (An aptitude test measures your capacity for learning a particular subject or occupational area.) One of the problems on the test is given below. Complete the problem. Consider each step carefully. Use a pencil or pen to complete each step and time yourself. Enter the time you start and finish and compute the total time. For this sample test, a correct answer in 60 seconds shows good programming aptitude. Your teacher will give you the correct solution.

PROGRAMMING APTITUDE TEST

Box No.	1	2	3	4	5	6	7	8	9	10
	8	3	4	2	71	6	33	4	9	1

Step 1. Add the number in box 3 + the number in box 2. Replace the number in box 7 with the result of your addition.

Step 2. Add the number in box 7 + the number in the box whose number is in box 6. Replace the number in box 6 with the result of your addition.

Step 3. Subtract the number in box 7 from the number in box 6. Replace the number in box 9 with the result of your subtraction.

Step 4. WHAT NUMBER IS NOW IN BOX 9? ____________________

Starting time: _____ Ending time: _____ Total time: _____

CAREERS IN DATA PROCESSING
UNIT X

ASSIGNMENT SHEET #4: ACHIEVEMENT TEST

Directions: Your first job interview is for a position as a data-entry clerk in a computer service bureau. You are given an achievement test in clerical speed and accuracy. (Achievement tests measure specific skills.) A portion of the achievement test is given below. Complete the test, timing yourself. Get the answers from your instructor. For this sample test, a perfect result in 30 seconds shows good clerical speed and accuracy achievement.

CLERICAL SPEED AND ACCURACY ACHIEVEMENT TEST

You will be given two addresses to compare. If they are exactly the same, place an S on the line at the right. If they are different, place a D on the right. Enter the time you start; finish and calculate your total time.

1.	9038 Lincoln Terrace	9038 Lincoln Terraces	_____
2.	3132 Rustic Road	3132 Rustic Road	_____
3.	141 Greenwhich Drive	141 Greenwich Drive	_____
4.	1413 Delouise Court	1431 Delouise Court	_____
5.	131 Mullany Street	131 Mullane Street	_____
6.	148 Peterle Street	148 Peterle Street	_____
7.	33 Howell Road	33 Howel Road	_____
8.	7090 Essex Drive	7009 Essex Drive	_____
9.	70 Girard Street	70 Girard Street	_____
10.	489 Maple	489 Maple Street	_____

Starting time: _____ Ending time: _____ Total time: _____

CAREERS IN DATA PROCESSING
UNIT X

ASSIGNMENT #5: RESEARCH PROJECT

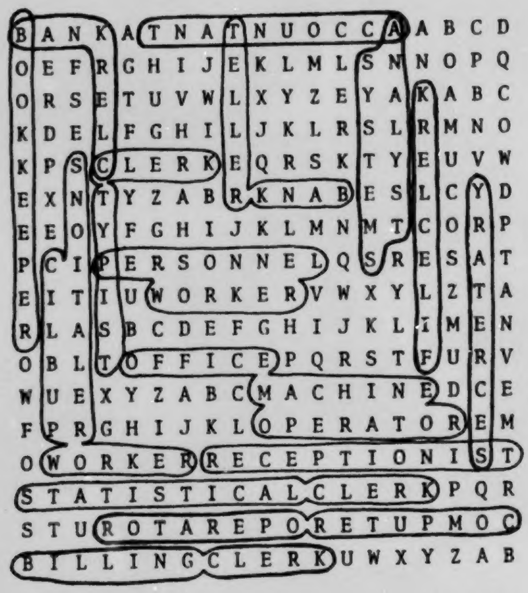
Directions: Think of a career in Data or Word Processing that you would like to enter in the future. Next, pretend you could go to any educational facility that you choose when you get out of high school. Your assignments are to:

1. Research the job you have chosen and write a report on your findings. Include such things as educational requirements, duties, salary, physical setting, and anything else you can find out about the job.
2. Research the educational facility of your choice. See your instructor or guidance counselor about possible materials. You may have to write to the facility about information. Include in your report location, cost, size, programs offered in Data or Word Processing, etc. Does the school offer a program in your desired area? If not, find one that does.

CAREERS IN DATA PROCESSING
UNIT X

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET #1



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B A N K A T N A T N U O C C A A B C D
O E F R G H I J E K L M L S N N O P Q
O R S E T U V W L X Y Z E Y A K A B C
K D E L F G H I L J K L R S L R M N O
K P S C L E R K E Q R S K T Y E U V W
E X N T Y Z A B R K N A B E S L C Y D
E E O Y F G H I J K L M N M T C O R P
P C I P E R S O N N E L Q S R E S A T
E I T I U W O R K E R V W X Y L Z T A
R L A S B C D E F G H I J K L I M E N
O B L T O F F I C E P Q R S T F U R V
W U E X Y Z A B C M A C H I N E D C E
F P R G H I J K L O P E R A T O R E M
O W O R K E R R E C E P T I O N I S T
S T A T I S T I C A L C L E R K P Q R
S T U R O T A R E P O R E T U P M O C
B I L L I N G C L E R K U W X Y Z A B
```

ASSIGNMENT SHEET #2

The interest checklist in this assignment is used to encourage students to evaluate their likes and dislikes. You may want to review and discuss each student's completed checklist in relation to his or her tentative career plans. Alert the student to apparent inconsistencies (for example, a career choice of manager by a student who does not enjoy working with people).

ASSIGNMENT SHEET #3

These assignments have one key objective - to reduce student apprehension concerning employment testing. Since the time allocations are important, you should use a stopwatch and have students begin these activities at a specified time. Review the correct answers as a class activity. Be certain to indicate that most tests will be substantially longer, which will put less weight on any single question.

ASSIGNMENT SHEET #4

1. D
2. S
3. D
4. D
5. D
6. S
7. D
8. D
9. S
10. D

ASSIGNMENT SHEET #5

To be evaluated by instructor

CAREERS IN DATA PROCESSING
UNIT X

PRETEST

Directions: In the space provided, place a "T" if the item is True or an "F" if the item is False.

_____ 1. Data entry has eliminated all handwritten communication in data processing operations.

_____ 2. An extensive background in higher mathematics is a requirement for successful employment in business data processing.

_____ 3. Typing, machine calculations, or cash register operations can all be considered excellent ways to develop the manual dexterity demanded of data-entry clerks and computer operators.

_____ 4. Data processing aptitude tests often include tests of clerical accuracy.

_____ 5. Many companies have training programs available to employees interested in preparing for a data processing career.

_____ 6. All data processing jobs require very little physical activity.

_____ 7. A person who performs well in an entry-level job, such as a data-entry clerk, may later be trained for a higher-level data processing job.

_____ 8. Both word processing operators and data-entry clerks must be able to key data accurately.

_____ 9. A systems analyst usually has a college degree, good planning skills, and the ability to work well with others.

_____ 10. A programming trainee must usually have a college degree.

_____ 11. The cost of using data processing equipment has been steadily increasing.

_____ 12. The number of terminals is expected to grow even faster than the number of computers.

_____ 13. In the years ahead we can expect a major increase in the number of paper documents being stored by businesses.

_____ 14. Computer use in education is expected to increase.

_____ 15. An interest test is designed to measure how well you are trained in a certain area.

CAREERS IN DATA PROCESSING
UNIT X

EVALUATION

1. Name the three characteristics desirable in all data processing employees.

   a.

   b.

   c.

2. Matching: Select the activity in Column 2 that best matches the skill in Column 1. Write the letter for the activity in the answer column. Each term is used only once.

   Column 1

   ____a. Communication skills

   ____b. Numeric skills

   ____c. Manual dexterity

   ____d. Clerical speed and accuracy

   ____e. Problem-solving skills

   Column 2

   1. Completing a typing course

   2. Working part time as a file clerk

   3. Taking a course in public speaking

   4. Learning to play chess

   5. Acting as scorekeeper for an athletic team

3. In what educational institutions would you receive training in data processing? Name three.

   a.

   b.

   c.

4. List three careers and their duties in manual data processing.

   Career Duties

   a.

   b.

   c.

5. List three careers and their duties in mechanical data processing.

Career Duties

a.

b.

c.

6. Discuss five careers in computer data processing.

a.

b.

c.

d.

e.

7. There were several things mentioned on the information sheet that will affect the future in data processing. Name and discuss three of these.

a.

b.

c.

8. Discuss two characteristics of the office of the future.

a.

b.

9. Discuss the outlook for a career in information processing.

CAREERS IN DATA PROCESSING
UNIT X

ANSWERS TO PRETEST

1. F
2. F
3. T
4. F
5. T
6. F
7. T
8. T
9. T
10. F
11. F
12. T
13. F
14. T
15. F

CAREERS IN DATA PROCESSING
UNIT X

ANSWERS TO EVALUATION

1. a. Patience
   b. Persistence
   c. Precision
2. a. 3
   b. 5
   c. 2
   d. 1
   e. 4
3. Any three of the following:
   a. Schools and colleges
   b. Specialized programs
   c. Technical schools
   d. Industrial training
   e. Military service
4. Any three of the following:
   a. Mail clerk - processes incoming and interoffice mail
   b. Clerk/typist - transfers data from source documents to business forms
   c. Accounting clerk - helps keep track of financial records
   d. File clerk - organizes and stores documents so they can be found quickly
   e. Input/output clerk - keeps track of the work that comes in and goes out of the data processing department
   f. Microfilm operator - catalogs the filmed documents and stores the film

5. Any three of the following:

   a. Addressing machine operator - prints address labels for outgoing mail

   b. Calculating or accounting machine operator - performs simple arithmetic needed for checking

   c. Word processing operator - skilled typist who uses an automatic typewriter

   d. Copy machine operator - operates duplicating machines, mimeograph machines, xerography machines, etc.

6. Use information sheet for careers in computer data processing.

7. Any three of the following:

   a. increased use of word processing

   b. increased use of COM (computer output microfilm)

   c. computer improvements

   d. terminals

   e. data communications

   f. industrial automation

8. a. disappearance of paper documents

   b. increased use of terminals

9. Evaluated by instructor

LAWS, ETHICS, AND ISSUES
UNIT XI

UNIT OBJECTIVE

After studying this unit, students should be sufficiently familiar with the laws, ethics, and issues involving various areas of data processing to discuss them intelligently.

SPECIFIC OBJECTIVES

After studying this unit, students should be able to:

1. Distinguish between a patent, copyright, and trade secret and correlate patents and copyrights with hardware and software.
2. Explain a contract and contract programming.
3. List the two cases against the International Business Machines Corporation for antitrust suits and the result of each.
4. Explain the difference between a computer utility and a computer network.
5. Recognize as true or false statements concerning taxation on the federal and state levels regarding software.
6. Explain the purpose of the Privacy Act of 1974 and the Electronic Funds Transfer Act.
7. List the two types of vandalism.
8. Explain when it is a crime to use a computer system without proper authorization; recognize as true or false statements on computer related fraud; and explain software piracy.
9. Explain DPMA and ICCP.
10. List ways in which human-machine interactions are dehumanizing.
11. List the four rights given to the individual by the Privacy Act of 1974 and some problem areas involving this privacy.
12. Explain computer literacy.
13. Explain artificial intelligence and robotics with its fear towards artificial intelligence/robotics.

14. Recognize as true or false statements regarding professionalism in data processing.

15. List features of the present-day and future automated office; list benefits and problems associated with the automated office.

16. Explain the operation, benefits, and problems associated with electronic funds transfer.

17. Recognize as true or false statements regarding the impact of computers on the job market.

18. Recognize as true or false statements regarding the information revolution.

LAWS, ETHICS, AND ISSUES
UNIT XI

NOTES TO INSTRUCTOR

Laws: The instructor should endeavor to ascertain the current status of the following legislation:

1. The Electronic Funds Transfer Act before Congress
2. State laws pertaining to the rights of the individual to privacy
3. Local laws pertaining to the rights of the individual to privacy
4. The taxation laws on the purchasing/leasing of hardware/software on the federal government level
5. The taxation laws on the purchasing/leasing of hardware/software on the state and local levels

Assignments: It is suggested that the students be divided so that any one student will do only one of the three assignments. Since oral communication is important, the instructor is encouraged to keep the assignments as described.

Assignment #1: The length of the article and the scope of the report should be determined by the instructor and given as additional instructions to this assignment.

Assignment #2: Free copies of the Institute for Certification of Computer Professionals' Code of Ethics and Codes of Conduct can be obtained from the following address:

Professional Book Distributors, Inc.
555 East Hudson Street
P.O. Box 02055
Columbus, OH 43202

Assignment #3: The scope of the subject and the debating procedure are left to the judgment of the instructor.

LAWS, ETHICS, AND ISSUES
UNIT XI

SUGGESTED ACTIVITIES

I. Instructor

  A. Make transparencies.

  B. Provide students with objectives and discuss.

  C. Provide students with information and assignment sheets and discuss.

  D. Give examination.

II. Student

  A. Read objectives.

  B. Study information sheets as presented and assigned by instructor.

  C. Complete assignment sheets.

  D. Complete examination.

INSTRUCTIONAL MATERIALS

I. Unit Content

  A. Objectives

  B. Notes to instructor

  C. Information sheets

  D. Transparency masters

    1. TM-XI-1: Patents, Copyrights, and Trade Secrets

    2. TM-XI-2: Computer Utility and Networks

    3. TM-XI-3: Individual Rights: Privacy Act of 1974

  E. Assignment sheets

    1. AS-XI-1: Oral Report on Article Concerning Laws

    2. AS-XI-2: Code of Conduct Guidelines

    3. AS-XI-3: Debate on an Issue

F. Answers to assignment sheets

G. Examination

H. Answers to examination

LAWS, ETHICS, AND ISSUES
UNIT XI

INFORMATION SHEETS

I. Laws (Refer to AS-XI-1.)

A. Patents, copyrights, and trade secrets (Refer to TM-XI-1.)

1. A patent gives the owner exclusive rights to an invention, usually original, for a period of 17 years (renewable for another 17 years) unless permission is granted and a royalty is paid.

2. A copyright gives the owner the right not to be copied for a period of 28 years (renewal for another 28 years) but gives no protection to the idea behind the work.

3. A trade secret is a common-law doctrine that gives a person exclusive rights to a process or formula against any improper disclosure or discovery for an unlimited amount of time.

4. In the area of hardware, there are mostly patents and copyrights.

5. In the area of software, there are mostly copyrights since the U.S. Patent Office generally says that it is not patentable.

6. Trade secrets remain such only as long as the hardware or software is not marketed; once available, it becomes common knowledge.

B. Contracts

1. A contract is a legal agreement stating the rights and the obligations of each of the parties.

2. A contract is needed for the purchase or lease of equipment, software, maintenance, and other services.

3. Contracts are a primary area of concern when an installation uses a variety of vendors for equipment, software, and services.

4. The creation of specific software by an outside source is called contract programming.

C. Litigation and antitrust laws

1. In 1969, under pressure from the federal government, competitors, and software houses, the International Business Machines Corporation was forced to separate the selling of hardware and software for the price of the hardware (the practice known as bundling).

2. In 1982, the federal government dropped an antitrust suit against the International Business Machines Corporation after pursuing it for almost thirteen years.

3. Conflict exists between the use of patents and copyrights and the restriction of competition and free trade. Exclusive use has been allowed to the point that other companies cannot manufacture comparable equipment.

D. Computer utility and networks (Refer to TM-XI-2.)

1. A computer utility sells the use of computer equipment and software to companies that may have totally diverse interests.

2. A computer network provides a central location for different agencies or branches of related concerns to share and exchange information.

3. The legal problems for either a computer utility or network are greater than for an individual company because a computer utility or network must provide service and security for many different interests.

E. Taxation

1. Some states consider purchased software to be subject to state sales tax, while others think that it is in the nature of nontaxable services.

2. The federal government has not yet decided if software should be considered an expense in the year purchased or as a depreciable capital asset.

F. Acts

1. The Privacy Act of 1974 restricts the release of data from files in federal agencies to persons who have a clear "right to know." (Several states have also passed laws to safeguard individual privacy.)

2. Congress is now considering the Electronic Funds Transfer (EFT) Act, which will be a comprehensive law governing banks, lending institutions, and clearing houses in regard to the use of computer networks in financial matters.

G. Computer crime: vandalism

1. Computer crime is a multimillion dollar problem and growing.

2. Types

a. Destruction of physical installations became such a problem during the student unrest of the sixties that most computer centers often restricted access to computer facilities.

b. Destruction of information contained in files or libraries on purpose is a crime; and if done by accident, it may be a crime if it can be proved that the individual was acting irresponsibly.

H. Computer crime: fraud

1. It is a crime to use a system without proper authorization if it deprives a legitimate user from access to the system or does not compensate the owner of the system if payment is required.

2. Embezzlement of funds and materials is the most publicized aspect of computer crime for it is regarded as the most glamorous of the white-collar crimes.

3. Falsification of records on computers is more difficult than on manual systems; consequently, computers have prevented more fraud than they have encouraged.

4. The selling of confidential information in the form of data or programs is becoming as much a problem as embezzlement.

5. The copying of programs without proper payment to the owner of the copyright is called software piracy.

II. Ethics (Refer to AS-XI-2.)

A. Professional groups

1. Data Processing Managers Association (DPMA) is a professional organization of data processing personnel that created the Institute for Certification of Computer Professionals (ICCP).

2. The ICCP created the Code of Ethics for Certified Computer Professionals and the Codes of Conduct and Good Practice for Certified Computer Professionals.

B. Code of Ethics for Certified Computer Professionals

1. Certified computer professionals, consistent with their obligation to the public at large, should promote the understanding of data processing methods and procedures using every resource at their command.

2. Certified computer professionals have an obligation to their profession to uphold the high ideals and the level of personal knowledge certified by the certificate held. They should also encourage the dissemination of knowledge pertaining to the development of the computer profession.

3. Certified computer professionals have an obligation to serve the interests of their employers and clients loyally, diligently, and honestly.

4. Certified computer professionals must not engage in any conduct or commit any act which is discreditable to the reputation or integrity of the data processing profession.

5. Certified computer professionals must not imply that the certificates which they hold are their sole claim to professional competence.

III. Issues (Refer to AS-XI-3.)

A. Dehumanizing effect of computers

1. Since the computer deals with names spelled with all capitals and with no punctuation (giving only a first and last name), many people are losing the uniqueness of their own name.

2. Human-machine interactions

a. Computer Assisted Instruction (CAI) is becoming more commonplace as the price of computers drops and teachers' salaries go up.

b. The business of video/computer games is one of the fastest growing industries in the country because of its popularity among young people.

c. There are now computer tellers, answering devices, catalog order takers, telephone information operators, cash registers, and many other situations that cause the general public almost daily contact with a computer system.

d. Computers are remarkable but are limited in both the variety and the nature of their responses; and according to some authorities, this limits the responses of people who constantly work with computers.

e. Computer environments have in the past emphasized the physical needs of the computer; consideration is now being given to the comfort and safety of the individual using the computer.

B. Privacy

1. Rights of the individual according to the Privacy Act of 1974 (Refer to TM-XI-3.)

   a. A person should have the right to know what data are maintained about them in a file in any federal agency.

   b. A person should have the right to challenge and correct any data that are erroneous or outdated.

   c. Data should be provided only to users who have an obvious need for and right to the information.

   d. Any person providing data should have a right to know how it is to be used and to whom it is to be available.

2. Some problem areas regarding privacy

   a. The selling of mailing lists from one organization to another, usually for the purpose of soliciting money from the individual

   b. Erroneous data on file may cause one to have a bad credit rating, or to be harassed by a company or collection agency, or even to be arrested for a crime one did not commit.

   c. Centralized files multiply the problem of erroneous data and may give wider unauthorized access to the information on file.

C. Computer literacy/education

1. A basic understanding of how a computer works and how to interact with one is called computer literacy.

2. Computers are now being introduced at lower grade levels and more intensely at all levels than ever before through the means of CAI.

3. Some school districts are considering the adoption of policy requiring student computer literacy as a condition for high school graduation.

D. Artificial intelligence/robotics

1. Artificial intelligence is the area of research involving a computer capable of making a rational decision on its own and learning from its own experience.

2. Robotics is an area of research in which a machine, without direct supervision, performs physical activities normally done by humans.

3. Both areas of study are in their infancy and have very limited usage at this time.

4. There is some fear that humans may create a "monster" which will think for itself and wish to dominate humanity.

E. Professionalism in data processing

1. There is a movement to have all programmers and systems analysts certified and licensed in the same manner as doctors or lawyers.

2. If a programmer or systems analyst is held responsible for the damages done to a company by software design and program, the employee may need to have malpractice insurance.

3. The idea of forming unions for personnel at the levels of data entry and operations is meeting strong opposition from management of almost all companies.

F. Automated office

1. "Automated office" is a term replacing the term "paperless office."

2. Presently the automated office has the following features:
    a. Word processing - the editing and production of text on a terminal device
    b. Electronic mail - the use of telecommunications to send and receive text
    c. Data processing on an elementary level
3. In the future, the automated office may also have the following features:
    a. Full data processing capabilities
    b. Voice input and output
    c. Sophisticated information storage and retrieval techniques
    d. Images - photographic quality reproduction on a printed page
    e. Graphics generated automatically from data
4. Benefits of the automated office are the following:
    a. Increases productivity of office staff
    b. Reduces office clerical costs
5. Problems with the automated office are the following:
    a. The equipment is now very expensive.
    b. The staff must be trained to operate the new machines.
    c. The staff must adjust their methods to the way the machine can understand.
    d. The field is expanding so rapidly that a machine is almost outdated by the time it is delivered.

G. Electronic funds transfer

1. Electronic funds transfer is often referred to as the beginning of the cashless society.

2. Electronic funds transfer would operate in the following manner:

    a. A person would be issued a card with information already enclosed.

    b. Deposits of payroll, receipts and other sources would increase the value of the card.

    c. Purchases and payments would reduce the value of the card.

    d. Records of all transactions would be communicated through a financial network to the institution that issued the card.

    e. Transfer of funds would then be done electronically between the institutions.

3. Benefits from electronic funds transfer would be the following:

    a. People would not have to write checks.

    b. There would be less motivation for robbery since the robber would need to know the correct password to use the card.

    c. The card would be convenient for individuals to use and carry.

4. Problems that would arise from electronic funds transfer are the following:

    a. Dramatic increase in competition between banks, lending institutions, credit card companies, and even major retail stores could mean the complete elimination of local institutions for a few very large and powerful companies that would dominate consumer finance.

    b. Individuals would not have a grace period provided when writing a check, hoping to be able to make a deposit before the check arrives at the bank.

    c. It would provide a great incentive for a new area of computer crime, the forging of cards.

H. Impact of computers on the job market

1. Computers, like every other item of technology, are accused of reducing the number of jobs available.

2. Computers do not change what is done but how it is done.

3. People replaced by computers have to be trained for new job needs.

4. People need almost continuous education because developments are so rapid that it appears there is a "planned obsolesence" of what exists now.

5. Computers will eventually free humans from job routines which would result in a shorter work week.

6. Communications will be sufficiently sophisticated to allow people to work in the comfort of their own homes for maybe several different companies located around the world.

I. Information revolution

1. The effect that computers will have by bringing information into the office and the home has been compared to the effect that the printing of books had at the beginning in the 15th century.

2. Information will be so readily available that the population will be much better educated.

3. Virtually any information desired by a person from historical dates, to hotel accommodations at a place halfway around the world, to watching a particular scene from a 1947 movie will be immediately accessible.

4. A person may well be able to shop for groceries, clothes, and any other items desired without ever leaving the house.

5. Because information from all parts of the globe will be so obtainable, the concepts of borders and nations may even give way to the idea of one planet and one people.

Patents, Copyrights, and Trade Secrets

Patent

A document which gives the owner exclusive rights to an invention, usually original, for a period of 17 years, unless a royalty is paid

Copyright

A document that gives the owner the right not to be copied for a period of 28 years, but does not protect the idea behind the work

Trade Secret

A common-law doctrine that gives the owner exclusive right to a process or formula against any improper disclosure or discovery for an unlimited amount of time

Computer Utility and Networks

Computer Utility

A company which sells the use of computer equipment and software to other companies that may have totally diverse interests

Computer Network

A company which serves as a central location for different agencies or branches of related concerns to share and exchange information

Individual Rights: Privacy Act of 1974

Persons should have the right to know what data are maintained about them in a file in any federal agency.

They should have the right to challenge and correct any data that are erroneous or outdated.

Data should be provided only to users who have an obvious need and right to the information.

Any person providing data should have a right to know how it is to be used and to whom it is to be available.

LAWS, ETHICS, AND ISSUES
UNIT XI

ASSIGNMENT SHEET #1: ORAL REPORT ON ARTICLE CONCERNING LAWS

Directions: The student should present an oral report based upon a magazine or newspaper article which pertains to any of the areas under the laws section of this unit. The instructor will give the time limits and any other necessary instructions for this assignment.

ASSIGNMENT SHEET #2: CODE OF CONDUCT GUIDELINES

Directions: Students should, as a committee, draw up guidelines for a code of conduct based upon the Code of Ethics of the Institute for Certification of Computer Professionals. The guidelines should be submitted in writing.

LAWS, ETHICS, AND ISSUES
UNIT XI

ASSIGNMENT SHEET #3: DEBATE ON AN ISSUE

Directions: Students should prepare to debate any one issue assigned to them in a manner designed by the instructor. Students should be able to support their statements with references from authorities.

LAWS, ETHICS, AND ISSUES
UNIT XI

ANSWERS TO ASSIGNMENT SHEETS

There are no specific answers to the assignment sheets, but suggested guidelines for grading are given for each.

ASSIGNMENT SHEET #1

The student should be graded on the following:

1. Content of the speech
2. Clarity of the presentation
3. Accuracy of the presentation
4. Use of voice and gestures in the presentation

ASSIGNMENT SHEET #2

Let the students rate each other on the following criteria:

1. Leadership
2. Contribution of ideas
3. Cooperation with others
4. Assistance in preparing report

ASSIGNMENT SHEET #3

The students should be graded on the following areas:

1. Content of the presentation
2. Clarity of the presentation
3. Accuracy of the presentation
4. The use of voice and gestures in the presentation
5. Ability to rebut and defend the presentation
6. The persuasiveness of the presentation

LAWS, ETHICS, AND ISSUES
UNIT XI

EXAMINATION

1. Match the following:

    ____a. Copyright

    ____b. Patent

    ____c. Trade secret

    1. Common-law doctrine giving the person exclusive rights to a process or formula

    2. Document that gives the owner exclusive rights to an invention

    3. Document that gives the owner the right not to be duplicated without proper payment

2. Patents and copyrights are usually associated with ______________________, while only copyrights are associated with ______________.

3. Define "contract."

4. When is a contract of primary importance to a company?

5. What is contract programming?

6. List the two cases against IBM for antitrust suits and the outcome of each.

7. Explain the difference between a computer utility and a computer network.

8. Circle the letter preceding each true statement about taxation.

   a. States differ in how they view the taxing of software.

   b. The federal government has a clear and definite regulation for the taxation of software.

9. What is the purpose of the Privacy Act of 1974?

10. Explain the purpose of the Electronic Fund Transfer Act.

11. List the two types of vandalism.

12. Explain when it is a crime to use a computer system without proper authorization.

13. Circle the letter preceding each true statement regarding fraud in using a computer.

    a. Embezzlement with the use of the computer is the least publicized of all computer crimes.

    b. Falsification of records is easier on a computer than with a manual system.

    c. The selling of confidential information is becoming a serious problem.

14. What is software piracy?

15. What are DPMA and ICCP?

16. List three ways in which human-machine interactions are dehumanizing.

17. List the four rights given to the individual by the Privacy Act of 1974.

18. List two problem areas regarding privacy.

19. What is computer literacy?

20. What is artificial intelligence?

21. What is robotics?

22. What is the fear that some people have of artificial intelligence/robotics?

23. Circle the letter preceding each true statement regarding professionalism in data processing.

   a. There is a movement to have all programmers and systems analysts certified and licensed.

   b. Programmers and systems analysts may need malpractice insurance in case they are responsible for damage done by their software to a company.

   c. Programmers and systems analysts should form unions.

24. List three features of the present-day automated office.

25. List three features of the automated office of the future.

26. List two benefits of the automated office.

27. List two problems of the automated office.

28. Explain how electronic funds transfer operates.

29. List two benefits of electronic funds transfer.

30. List two problems with electronic funds transfer.

31. Circle the letter preceding each true statement concerning the impact of computers on the job market.

    a. The computer is not like any other item of technology in how it affects the job market.

    b. Computers do not change what is done but how it is done.

    c. People need almost continuous education to keep up with the rapid advancement of computers.

    d. Computers will never be so sophisticated as to allow persons to work in their own homes for a company far away.

32. Circle the letter preceding each statement concerning the information revolution.

    a. Readily available information will cause the population to be better educated.

    b. People will be able to go shopping for anything without leaving the home.

LAWS, ETHICS AND ISSUES
UNIT XI

ANSWERS TO EXAMINATION

1. a. 3
   b. 2
   c. 1

2. hardware, software

3. A contract is a legal agreement stating the rights and the obligations of each of the parties.

4. A contract is of primary importance to a company when an installation uses many vendors.

5. Contract programming occurs when a company goes to an outside source to have specific software created.

6. In 1969, IBM was forced to unbundle its hardware and software.
   In 1982, the federal government dropped its antitrust suit against IBM.

7. A computer utility may serve a diverse group of companies, while a network is set up to serve as a central location for different agencies or branches that have a common concern.

8. Only "a" should be circled.

9. The Privacy Act of 1974 restricts the release of data from files in federal agencies to persons who have a clear "right to know."

10. The Electronic Funds Transfer Act will be a comprehensive law governing the use of computer networks in financial matters.

11. Destruction to the physical installation
    Destruction to the information in files and libraries

12. If it deprives a legitimate user from access to the system or does not compensate the owner of the system if payment is required

13. Only "c" should be circled.

14. Software piracy is the duplicating of software without proper payment to the owner of the copyright.

15. DPMA is the Data Processing Managers Association, which is an organization of data processing personnel that created ICCP.
ICCP is the Institute for Certification of Computer Professionals, which created the Code of Ethics for Certified Computer Professionals.

16. Any three of the following:

    a. Computer Assisted Instruction (CAI) replacing teachers
    b. Video/computer games
    c. Computer tellers, answering devices, catalog order takers, etc.
    d. Computer's limited response limiting the user's response
    e. Computer not necessarily designed for the comfort and safety of the user

17. The rights of the individual according to the Privacy Act of 1974 are these:

    a. A person should have the right to know what data are maintained about him/her in a file of any federal agency.
    b. An individual should have the right to challenge and correct any data that are erroneous or outdated.
    c. Data should be provided only to users who have an obvious need for and right to the information.
    d. Any person providing data should have a right to know how it is to be used and to whom it is to be available.

18. Any two of the following:

    a. The selling of mailing lists from one organization to another
    b. Erroneous data on file may cause problems for the individual.
    c. Centralized files multiply the problems of erroneous data and unauthorized access.

19. Computer literacy is having a basic understanding of how a computer works and how to interact with one.

20. Artificial intelligence is the area of research involving a computer capable of making a rational decision on its own and learning from its own experience.

21. Robotics is the area of research in which a machine, while not being under supervision, does physical activities that humans normally do.

22. Some people fear that artificial intelligence/robotics will create a machine that will think for itself and try to dominate humanity.

23. Only "a" and "b" should be circled.

24. a. Word processing
    b. Electronic mail
    c. Simple data processing

25. Any three of the following:

    a. Full data processing capabilities
    b. Voice input and output
    c. Sophisticated information storage and retrieval methods
    d. Images of photographic quality
    e. Graphics generated automatically from data

26. a. Increases productivity of office staff
    b. Reduces office clerical costs

27. Any two of the following:

    a. The equipment is now very expensive.
    b. The staff must be trained to operate the new machine.
    c. The staff must adjust their methods to the machine.
    d. The machine is almost outdated by the time it is delivered.

28. a. A person is issued a card containing personal information encoded.
    b. Deposits increase the value of the card.
    c. Purchases and payments decrease the value of the card.
    d. Records of all transactions would be communicated through a financial network to the institution that issued the card.
    e. Transfer of funds would then be done electronically between the institutions.

29. Any two of the following:

    a. People would not have to write checks.
    b. There is less motivation for robbery.
    c. It would be convenient for the individual.

30. Any two of the following:

    a. Increased competition could cause the elimination of the local institutions for a few powerful companies that dominate consumer finance.
    b. Individuals would not have the grace period provided when writing a check and hoping to be able to make a deposit before the check arrives at the bank.
    c. There would be a new computer crime of forging cards.

31. Only "b" and "c" should be circled.

32. Both "a" and "b" should be circled.

APPENDICES

APPENDIX A

DATA PROCESSING, VOLUME I

RESOURCES

TEXTBOOKS

(These books contain generally accepted concepts and principles of data processing. Select units or chapters from several to use as reference material for your lectures and/or student use.)

Clark, Dana. *Classroom Notes for Fundamentals of Computer Science*. Dubuque, IA: Kendall/Hunt Publishing Company, 1981.

Condon, Robert J. *Data Processing with Applications*. 2nd ed. Reston, VA: Reston Publishing Company, Inc., 1981.

Couger, J. Daniel and McFadden, Fred R. *First Course in Data Processing with BASIC, COBOL, FORTRAN, RPG*. 2nd ed. New York: John Wiley & Sons, 1981.

Dock, V. Thomas and Essick, Edward L. *Principles of Business Data Processing with MIS. . .Including BASIC*. 4th ed. Chicago: Science Research Associates, Inc., 1981.

Feingold, Carl. *Introduction to Data Processing*. 3rd ed. Dubuque, IA: Wm. C. Brown Company Publishers, 1980.

Fuori, William M. *Introduction to the Computer*. 3rd ed. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1981.

Mandell, Steven L. *Computers and Data Processing--Concepts and Applications with BASIC*. 2nd ed. St. Paul: West Publishing Company, 1982.

Price, Wilson T. *Data Processing: The Fundamentals*. New York: Holt, Rinehart, and Winston, 1982.

Sardinas, Joseph L., Jr. *Computing Today--An Introduction to Business Data Processing*. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1981.

Silver, Gerald A. and Silver, Joan B. *Data Processing for Business*. 3rd ed. New York: Harcourt Brace Jovanovich, Inc., 1981.

Spencer, Donald D. *Data Processing--An Introduction with BASIC*. 2nd ed. Columbus, OH: Charles E. Merrill Publishing Co., 1982.

Spencer, Donald D. *Introduction to Information Processing*. 3rd ed. Columbus, OH: Charles E. Merrill Publishing Co., 1981.

Stair, Ralph M., Jr. Principles of Data Processing. Homewood, IL: Richard D. Irwin, Inc., 1981.

Stern, Robert A. and Stern, Nancy. An Introduction to Computers and Information Processing. New York: John Wiley & Sons, 1982.

Tomeski, Edward A., et al. Fundamentals of Computers in Business--A Systems Approach. San Francisco: Holden-Day, Inc., 1979.

Wu, Margaret S. Introduction to Computer Data Processing with BASIC. New York: Harcourt Brace Jovanovich, Inc., 1980.

Available from South-Western Publishing Company.

Computers, People, and Data. Wood, Merle W. 1972.

Paperback text-workbook. Topics include what the computer is, the data processing cycle, the computer center, data processing operations, and the flow of data. A teacher's manual is available.

Exploring Data Processing Careers. Baggett, Harry W. 1975.

Paperback text-workbook. Introduces students to careers in data processing--20-25 clock hours. Illustrated. Equipment not required. A teacher's manual is available.

Fundamentals of Data Processing. Wanous, S. J., E. E. Wanous, and Gerald E. Wagner.

Includes flowcharting and programming concepts. Designed for a one-semester course. Teacher's manual and practice set are available. Does not require equipment.

Introduction to Automated Data Processing (2nd ed.). Wanous, S. J., Gerald E. Wagner, and Stephen F. Hallam. 1979.

Spiral-bound text. Work kit and instructor's manual available. Written to give the beginning student an understanding of data processing operations as they apply to the electronic computer. The following programming languages are covered: FORTRAN, BASIC, COBOL.

Introductory Data Processing. Wanous, S. J., E. E. Wanous, and Gerald E. Wagner. 1973.

Paperback text and projects booklet. Equipment not required. Automated data processing concepts are covered.

You are a Data Processor. Wood, Merle W. 1972.

Paperback text-workbook. Covers data processing concepts through the use of a punched card. Easy to read.

Available from Gregg/McGraw-Hill Publishing Company

Computers and Data Processing. Gore, Marvin R. and John W. Stubbe. 1979.

Text, study guide, and teacher's manual. Provides for "hands on" activities. Appendix includes introduction to BASIC, COBOL, FORTRAN, and RPG programming languages.

Data Processing. Lipschutz, Martin M. and Seymour Lipschutz. 1981.

Schaum's Outline Series with Theory and Problems of Data Processing including 420 solved problems.

Data Processing Systems and Concepts. Verzello, Robert J. and John Reutter, III. 1982.

Introduction to Business Data Processing (2nd ed.). Orilia, Lawrence S. 1982.

Introduction to Data Processing. Robichaud, Beryl, Eugene Muscat, and Alix-Marie Hall. 1977.

Text, workbook, teacher's source book, and key. Covers concepts of data processing, computers and business, systems and procedures, and careers. Equipment not required.

Microprocessing Fundamentals. Ramirez, Edward V. and Melvyn Weiss.

Text with end-of-chapter problems and instructor's manual.

Available from Camelot Publishing Company, Inc., P.O. Box 1357, Ormond Beach, FL 32074

BASIC: A Unit for Secondary Schools (2nd ed.). Spencer, Donald D. 1980.

Programs included were typed and run on Radio Shack TRS-80 and Apple II microcomputers. Teacher's manual available.

BASIC Flash Cards. 1979.

Flash cards for teaching about the BASIC language and programming.

Posters on Computers. Spencer, Donald D. 1978.

Posters on Computers in Everyday Life. Spencer, Donald D. 1978.

Some People Just Won't Believe A Computer. Spencer, Donald D. 1978.

A cartoon collection of computer humor

Visual Masters for Teaching About Computers. Spencer, Donald D. 1978.

Visual Masters for Teaching Basic Programming. Spencer, Donald D. 1978.

What Computers Can Do. Spencer, Donald D. 1980.

Explanation of practical applications of computers and how they aid people in their everyday work.

Available from Anaheim Publishing Company, 1120 E. Ash, Fullerton, CA 92631

Introduction to Computers and Data Processing. Shelly, Gary B. and Thomas J. Cashman. 1980.

Paperback. Study guide, workbook, and teacher's manual available. Illustrated with approximately 500 color photographs.

Introduction to Flowcharting. Shelly, Gary B. and Thomas J. Cashman.

Provides instruction in the basic logic and flowcharting of buisness applications programming. Text-workbook and teacher's manual.

The Computers in our Society. Logsdon, Tom and Fae Logsdon. 1974.

Provides a painless introduction to the role of computers in our society.

Other Books:

BASIC and the Personal Computer. Dwyer, Thomas and Margot Critchfield. Addison-Wesley Publishing Co., Reading, MA 01867.

Basic BASIC: An Introduciton to Computer Programming. Coan, James S. Hayden Publishing Company, 6304 Hamilton Avenue, Cincinnati, OH 45224.

BASIC for Home Computers. Albrecht, Finkel, and Brown. John Wiley and Sons, One Wiley Drive, Somerset, NJ 98873.

BASIC Primer. Waite, M. and M. Pardee. Howard W. Sams and Company, Inc., 4300 West 62nd Street, Indianapolis, IN 46206.

Business Computer Systems: An Introduction. Kroende, David M. Mitchell Publishing Co., Inc., Santa Cruz, CA 95060. 1981.

Getting Acquainted with Microcomputers. Frenzel, Louis E. Howard W. Sams and Company, Inc., 4300 West 62nd Street, Indianapolis, IN 46206.

First Book of Microcomputers. Moody, Robert. Hayden Publishing Company, 6304 Hamilton Avenue, Cincinnati, HO 45224.

Fundamentals of Digital Computers. Spencer, Donald D. Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, IN 46206. 1969.

Guided Tour of Computer Programming in BASIC. Dwyer, Thomas and Michael Kaufman. Houghton-Mifflin Company, 1900 S. Batavia Avenue, Geneva, IL 60134. (Region 2 address)

Home Computer Revolution. Nelson, Ted. The Distributors, 702 South Michigan, South Bend, IN 46618.

Introduction to Microcomputers. Osborne, Adam. Creative Computing, P.O. Box 789-M, Morristown, NJ 07960.

Introduction to Personal and Business Computers. Zaks, Rodney. Sybex, 2020 Milvia Street, Berkeley, CA 94704.

Little Book of BASIC Style. Nevison, John M. Addison-Wesley Publishing Co., Reading, MA 91867.

My Friend the Computer. Rice, Jean. T. S. Denison and Co., 9601 Newton Avenue South, Minneapolis, MN 55431.

What to Do After You Hit Return. Albrecht, Bob. Creative Computing, P.O. Box 789-M, Morristown, NJ 07960.

Available from Dilithium Press, P.O. Box 92, Forrest Grove, OR 97116.

> *Home Computers: A Beginner's Glossary and Guide*. Miller, Merl K. and Charles J. Sippl. 1978.
>
> A quick reference source for beginners in data processing.
>
> *My Computer Likes Me When I Speak BASIC*. Albrecht, Bob. 1977.
>
> Introduction of BASIC for first-time users.
>
> *Peanut Butter and Jelly Guide to Computers*. Willis, Jerry. 1978.
>
> Contains case studies--a combination of consumer's guide and tutorial.
>
> *Your Home Computer*. White, James. 1977.
>
> Discusses aspects of the home computer. Includes lists of manufacturers, periodicals, clubs, and computer stores.

Available from Houghton-Mifflin Publishing Co., 1900 S. Batavia Avenue, Geneva, IL 60134. (Region 2 address)

A Guided Tour of Computer Programming in BASIC. Dwyer, Thomas A. and Michael S. Kaufman.

Presentation of elementary statements and commands.

Business Data Processing. Brabb, George J. and George J. McKean. 1982.

Flowcharting. McQuigg, James D. and Alta M. Harness.

Explanation of flowcharts and flowchart development. Can be used with or without a computer.

Introduction to Computer Programming. Copp, David H. and Rudd A. Crawford, Jr.

Introduction to computer programming in simple terms.

Introduction to Data Processing with BASIC (2nd ed.). Popkin, Gary S. and Arthur H. Pike. 1981.

What is a Computer? Ball, Marion J.

Introduction to computers, flowcharting, and history and function of computers.

REFERENCES

Computer Dictionary, 2nd ed. Spencer, Donald D. Camelot Publishing Company, 1979.

About 2,500 words, phrases, and acronyms used in connection with computers.

Computer Dictionary and Handbook. Sippl, Charles J. and Charles P. Sippl. Howard W. Sams and Company, Inc.

Dictionary of computer-related terms and reference material.

The Computer Quiz Book. Spencer, Donald D. Camelot Publishing Company.

Multiple-choice questions and crossword puzzles; includes answers.

Dictionary of Occupational Titles. Published by the Department of Labor, Bureau of Employment Security.

The Illustrated Computer Dictionary. Spencer, Donald D. Camelot Publishing Company, 1980.

Contains 270 pictures and 3,000 words, phrases, and acronyms.

Information Processing. A curriculum guide developed by the Mid-America Vocational Curriculum Consortium, Inc., 1981. Printed by the State Department of Vocational and Technical Education, Stillwater, OK 74074.

Introduction to Computer Programming. Brainerd, Walter S., Charles H. Goldberg, and Jonathan L. Gross. New York: Harper and Row, Publishers. 1979.

Introduces computer programming to students with no special background in mathematics. Contain over 200 complete programs and executions and over 500 exercises.

Microcomputers at a Glance. Spencer, Donald D. 1977.

Paperback reference. Illustrated definitions of about 2,500 terms used in conjunction with microcomputers.

PPC's Reference Book of Personal and Home Computers. Creative Computing, P.O. Box 789-M, Morristown, NJ 07960.

SRA Data Processing Glossary. Malstrom, Robert C. Chicago: Science Research Associates, Inc. 1979.

Contains over 5,000 definitions of terms used in data processing.

Using BASIC in the Classroom. Spencer, Donald D. Camelot Publishing Company, 1978.

Contains activities, strategies, and ideas for teaching BASIC programming in secondary schools.

SOURCES OF CAREER INFORMATION

American Federation of Information
Processing Societies
210 Summit Avenue
Montvale, NJ 07645

Association for Computing Machinery
1133 Avenue of the Americas
New York, NY 10036

Data Processing Management Association
505 Busse Highway
Park Ridge, IL 60068

Professional Programmers Association
c/o C. E. Powell
2724 N. 22nd Street
Phoenix, AZ 85009

APPENDIX B

DATA PROCESSING, VOLUME I

GLOSSARY OF TERMS

Access time - the waiting time between a request for data and the actual data transfer

Account - a record which summarizes changes resulting from business transactions

Accrued expense - an expense incurred but not yet paid

ADD - a reserved word which causes addition of numeric values

Adjusting entries - journal entries made at the end of an accounting period to bring general ledger accounts up to date

AFTER ADVANCING - an optional reserved word used to control spacing in printed output

Analog computer - a calculating machine that uses measurements to represent quantities that can be measured. Analog computers are not studied in this chapter.

Application programs - programs stored on disks, tapes, etc., and called into main storage when needed. Each program is a sequence of precise instructions to the computer telling it where to get input, how to process it, and where to put the results. (payroll, accounts receivable, etc.)

Arithmetic expressions - specifications of the computations to be performed or the value to be obtained

Assembler - a translate program which converts one language instruction into one machine instruction

Assets - items of value owned by a business or an individual

ASSIGN - a reserved word used to relate a file to a particular input-output device

Balance sheet - a business report showing the assets, liabilities, and capital on a specific date

Book value - the difference between cost and accumulated depreciation of a plant asset

Buffer - a storage area designed to hold data temporarily

Bugs - errors in a program which cause it not to run correctly

Bus - a group of circuits which provides communication paths between elements of a computer system

Byte - unit of computer memory which can represent any digit, letter of alphabet, or special character; smallest unit of memory that can have an address

Bytes Per Inch (BPI) - the number of bytes contained per inch of tape media. A byte usually consists of 8 bits.

Capital - the equity of the owner of a business

Capital statement - a statement showing a summary of changes in capital over a specified period of time to yield a current capital balance

Cathode-Ray Tube (CRT) - a television-like device with screen which displays input and output instead of printing input and output

Central Processing Unit (CPU) - that part of a computer that receives and stores instructions and data, performs arithmetic and logic operations, and directs action of input and output units

Characters Per Inch (CPI) - the number of characters recorded per inch of media. Each column on a punched card contains one character.

Chart of accounts - a list of the accounts and their numbers for a business

CLOSE - a reserved word which terminates processing of units or files

Closing entries - journal entries which close all revenue and expense accounts

Compiler - a translate program which converts one language instruction into many machine instructions

COMPUTE - a reserved word which assigns to a data item the value of a numeric data item, literal, or arithmetic expression

Computer - an information-handling device in which data and instructions for processing data are represented by electronic codes or impulses

Computer Assisted Instruction (CAI) - a process by which students use computers directly for learning new subjects

Conditional branch - a branch which is made when a specific condition is met

Connector symbol - a flowchart symbol which connects parts of involved flowcharts when flowlines are impractical

Constant - a data item whose value does not change

Control unit - the unit which controls and supervises the entire computer system

Credit - an amount entered on the right side of an account

Data adaptors - devices that convert data from the form used by the device to the form required by the computer system

Data entry - the recording of human readable data into a form that an input device can interpret for the computer system

Data entry operator - the person who records human readable data from a source document into a form that is machine understandable

Data field - one or more related characters representing a specific data element, such as name, quantity, or dollar amount

Data input - the process of transferring machine readable data into the computer system for processing

Data output - the process of producing information and data in a form that is readable and usable by humans or computer input devices

Data processing - converting information into usable form

Data record - a group of related data fields, such as all data pertaining to one employee

Debit - an amount entered on the left side of an account

Decision symbol - flowchart symbol which shows where a test for a specific condition is made

Decision table - a table consisting of six sections which is used for program planning

DEF - a program command which defines a formula as a function

Depreciation - a decline in value of an asset which accumulates over the life of the asset

Digital computer - a computer that works with numbers or letters of the alphabet and special characters that can be coded numerically. Solves problems electronically by counting, adding, subtracting, multiplying, and dividing. All references in this chapter refer to digital.

DIM - a program command which reserves a specific amount of space for a list and/or table

DISPLAY - a reserved word used to print brief messages on the console typewriter, the printer, or card punch

DIVIDE - a reserved word which causes division of numeric values

Divisions - Identification, Environment, Data, and Procedure are divisions used in COBOL.

Documentation - an assortment of material which provides information about the problem and the program written to solve the problem

DO-UNTIL - a looping logic statement used in pseudocode to continue looping until a condition becomes true

DO-WHILE - a looping logic statement used in pseudocode to continue looping as long as a condition is true

END - a program command which indicates to the computer the end of the program statements

Execution time (E-time) - the time required for the computer to perform the instruction

Exponentiation - the process of raising a number to a power

FD - an abbreviation for File Description which describes needed files

Field name - a storage location which can be a constant or a variable

FILLER - a reserved word used when some characters in a record are not used in processing

Financial statements - the income statement, capital statement, and balance sheets of a business

Firmware - system programs which are stored in Read-Only Memory

Flippies - small floppy disks which record on both sides

Floppy disk - small, flexible magnetic platter that is something like a phonograph record. One disk holds as much data as 3,000 eighty-column cards.

Flowchart - a pictorial form using standardized symbols to illustrate program logic

Flowlines - lines connecting flowcharting symbols to show sequence

FOR-TO and NEXT - related program commands which set up an automatic loop with a beginning and an ending

Function - a built-in formula which calculates a value

GOSUB - a program command which transfers control to the beginning of a subroutine

GO TO - a reserved word which transfers program control; a program command which causes an unconditional branch

Hardware - term used to describe any physical equipment or components in an electronic computer system

Housekeeping (Initialization) - setting beginning field names equal to zero or other chosen value

IF-THEN - a decision logic statement used in pseudocode to decide if a process should be done or not; a program command which causes a conditional branch if a specific condition is met

IF-THEN-ELSE - a decision logic statement used in pseudocode to decide which process to do

Income statement - a statement which shows a summary of revenue and expenses to determine net income for a specified period of time

Input - data that enter system for processing

INPUT - a program command which allows input of data in conversational mode

Input/Output Control Systems (IOCS) - an interrelated group of programs which pick up and interpret instructions and then initiate and control the necessary transfer of data to or from main storage

Input/output symbol - a flowchart symbol which indicates when to input data and when output is desired in a flowchart

Input prompt - a symbol telling the operator when to input data

Instruction time (I-time) - the time required to bring an instruction into the control unit and decode the instruction

Internal storage (memory) - memory of CPU

Interpreter - a program which translates each language instruction as the program runs

Journal - a book in which each business transaction is entered originally

Journalizing - the process of recording transactions in a journal

K (kilobyte) - usually considered as 1,000 bytes or exactly 1,024 bytes

LABEL RECORDS - a reserved word which specifies the presence of nonstandard labels on a file or the absence of labels

Languages - different ways of communicating with the computer

Ledger - all of the accounts of a business

LET - a program command which can be used to assign a value to a variable and to perform calculations

Liabilities - amounts owed by a business or individual

List - a string of related data items which can be identified

Loop - repeated logic used by more than one set of data

Machine language - any language that can be understood and carried out by the computer

Magnetic Ink Character Reader (MICR) - an input device used to process data printed in magnetic ink with specially designed numbers and symbols

Mainframe - larger computers; the heart of the computer system to which all other devices are connected

Megabyte - one million characters or bytes

Microfiche - a rectangular piece of film on which images have been replaced and recorded. One card can hold between 60 and 98 pages of copy.

Microseconds - a millionth of a second

Milliseconds - one-thousandth of a second

Minicomputer - a small, inexpensive computer that has CPU and one or more input/output devices; often low enough in price that it can be purchased rather than rented

Minus asset (contra asset) - an asset account which has an abnormal credit balance but is closely related to an asset with a normal balance

Mixed accounts - accounts containing an amount which is partly expense and partly asset

MOVE - a reserved word which moves data from one storage area to another or moves fields to be printed from input to output

MULTIPLY - a reser[illegible] which causes multiplication of numeric values

Multiprocessing - a system utilizing more than one CPU in the same system

Nested loop - a loop which is totally inside another larger loop

Net income - the amount by which revenues exceed expenses

Net loss - the amount by which expenses exceed revenues

Nibble - term given to 4 bits or one-half an 8-bit byte

Nonvolatile storage - storage in which contents are retained if power or current is turned off

Object program - a solution of a problem written in machine readable code

Off-page connector - a flowchart symbol which continues a flowchart to a new page

ON - a program command which causes a conditional branch to one of several locations

OPEN - a reserved word which makes an area available for development of input-output files

Operand - a name portion which tells the CPU location of data to be manipulated

Operating system - the master program that controls the operation of the computer. It must be loaded into the computer's main storage before any processing can take place. The operating system controls the movement of data through a computer system as the system carries out the instructions specified in an application program.

Operating systems acronyms

1. DOS/VS (Disk Operating System/Virtual Storage)

2. OS/VS1 (Operating System/Virtual Storage 1)

3. OS/VS2 (Operating System/Virtual Storage 2)

   (NOTE: These are various disk-resident comprehensive collections of programs designed to make full use of the resources of the various models of the IBM System/370.)

Operation code - code which tells the computer which operation to perform

Optical Character Reader (OCR) - a device that uses optical means to identify graphic characters

OPTION BASE - a program command which begins a list or table with an item 1 instead of an item 0

Output - processed information

Parallel operation - concurrent execution of two or more operations in the Arithmetic/Logic Unit (ALU)

Parity - a quality relating to the maintenance of a sameness of level or count, i.e., keeping the same number of binary ones in a computer word to thus be able to perform a check based on an even or odd number for all words under examination

Peripheral devices - various units or machines that are used in combination or conjunction with the computer but are not part of the computer itself, such as typewriter, sorters, tape readers

Permanent accounts - accounts which are not closed, i.e., asset, liability, and capital accounts

PICTURE (PIC) - a reserved word which describes in detail an elementary level data item

Plant assets - assets with a long life

Point-of-Sale Terminal (POS) - a device used to record purchases of customers, such as a cash register

Post-closing trial balance - a report that verifies the equality of debits and credits after closing all temporary accounts

Posting - the orderly transfer of data from a journal to a ledger

Prepaid expenses - items which are current assets at the time of purchase but that will be consumed in the operation of business

Preparation symbol - a flowchart symbol which assigns a value to a field when flowcharting

PRINT - a program command which causes the computer to display or print desired output

PRINT literal - a program command which tells the operator what data and in what form to enter the data

Process symbol - a flowchart symbol which indicates where computations are needed in a flowchart

Pseudocode (PDL) - an imitation of actual computer instructions used for program planning

Random access - a direct method of accessing data regardless of position in file

RANDOMIZE - a program command which selects a starting point to generate a table of random numbers

READ - a reserved word which makes available a logical record from input

READ and DATA - related program commands. READ causes data to be read into the computer from the DATA statement.

RECORD CONTAINS - a reserved word which specifies maximum size of the logical

REM - an unexecuted program command which contains comments regarding the program

Reserved words - words with preassigned meanings which are not used for other purposes. Source materials usually capitalize reserved words.

RESTORE - a program command which causes the computer to read the first data item again in READ-DATA

RETURN - a program command which transfers control to the statement following the last executed GOSUB

RND - a program function which generates a random number

ROUNDED - an optional reserved word used to round up if low-order digit is five or more and drop if low-order digit is less than five

SELECT - a reserved word used to name each file in a program

Sequential access - a storage technique in which stored items of data become available only in one-after-the-other sequence, whether all information in record or only some of it is desired

Serial operation - type of information transfer which performs operation on digits sequentially

SIGN - a reserved word which indicates presence of an operational sign, especially negative

Software - a term used to describe programs (instructions) that cause hardware to function

Source document - a document from which raw or original data is obtained

Source program - the solution of a problem readable by a programmer in a higher level language

STOP - a reserved word which ends program execution

String variable - an alphanumeric field name

Subroutine - a mini-program within a program

Subscripted variable - a variable containing a character enclosed in parentheses defining a storage position in a list or table, such as D(6)

SUBTRACT - a reserved word which causes subtraction of numeric values

Syntax - the rules regarding spelling, punctuation, and grammar

TAB - a program command which causes the computer to skip a desired number of spaces when outputting

Table - a string of related data items arranged in rows and columns

Temporary accounts - accounts which are closed at the end of an operating period, i.e., revenue, expense, income summary, and owner's drawing accounts

Terminal - an input/output device consisting of typewriter keyboard and printer or display; enables user to have contact with computer

Terminal symbol - a flowchart symbol which indicates beginnings, pauses, and endings

Test data - data with known answers to test program accuracy

Transfer time - the time required to move data from one location to another location

Trial balance - a report that verifies the equality of the debits and the credits in the ledger

Unconditional branch - a branch which is always made

Universal Product Code (UPC) - a symbol adopted by the food industry. It is made up of a series of vertical bars that reflect light from an optical scanner. The bars are a coded form of numbers.

Unsubscripted variable - a variable name without a character enclosed in parentheses, such as D

VALUE - a reserved word used to specify the initial value of working-storage items

Variable - a data item whose value is changeable

Virtual storage - storage which allows the programmer to use secondary storage to store programs or parts of programs that require more primary storage than is available

Volatile temporary storage - storage in which loss of power or current causes loss of all data and information stored

Word processing - the production of readable information using efficient management of people, procedures, and equipment

Work sheet - a form which provides for the sorting and interpreting of the trial balance

WRITE - a reserved word which causes a line to be printed from an output area